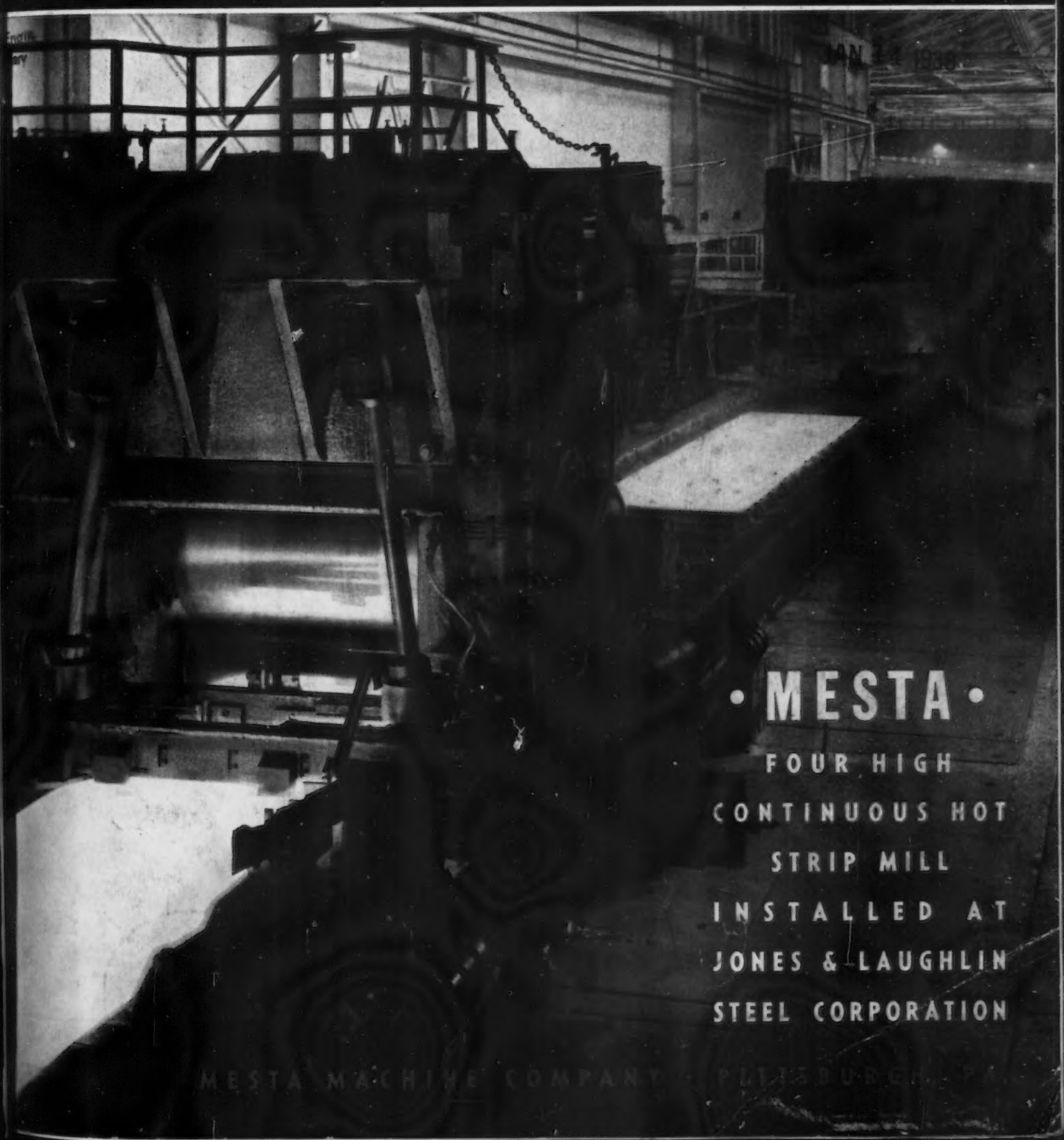
ANUARY 6, 1938

THE IRON AGE



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THE IRON AGE

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JANUARY 6, 1938

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Vol. 141, No. 1

What of 1938?

DURING the past few months business men have seen their volumes shrink with startling rapidity. Workers have seen their pay envelopes vanish altogether or, at best, become thinner and thinner. Government officials have found their promises of "planned prosperity" increasingly shattered by the impact of reality.

Two of these parties, at least, are now learning something. They are learning that they have a common interest in making and keeping what we call "business" as good as it can possibly be made and kept.

If this depression drives home the truth of this obvious fact, it will be worth more to America than all of our previous booms and boomlets. Because it will teach us that we can go further and faster pulling together than pulling apart.

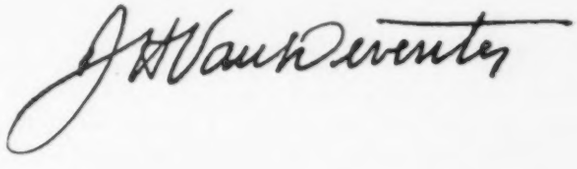
Employers are learning that employment is their best customer. That labor without jobs or with diminished purchasing power means decreased activity, shrinking profits and red ink. That one man on a payroll at good wages is worth three men on relief as buyers of industrial products.

Labor is beginning to learn that the most eloquent promisers generally turn out to be the poorest performers and providers. That legislation cannot create jobs or wages but that it can diminish them, particularly tax legislation which takes the cream away from industry's profits which might otherwise be shared by labor. That the worker must beware of the man who offers to better his lot at a price, whether that price be political support or financial payments.

And what is Government learning? Apparently not much at this writing. But it is due to learn a great deal during 1938 if the worker, as he will, learns that he and his employer have a common interest in maintaining business at a high level.

Business, during 1937, presented its case to our legislators without perceptible results. During 1938 it should present its case to labor, with which it has a fundamental common interest. Union as well as non-union labor depends upon the prosperity of business for its well-being. It will make common cause with employers if it can be shown that by so doing it can help attain the true "social security" represented by full pay envelopes.

The keynote for 1938 is industrial relations; the development, by employers and workers, of the factors of interest common to their mutual welfare.



Boom to Within

. . . HIGH POINTS

BY C. E. WRIGHT
Managing Editor, The Iron Age

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STEEL ingot production, with December estimated, was about 49,500,000 tons of open-hearth and bessemer steel, about 50,250,000 tons with electric and crucible added.

Pig iron output was about 36,800,000 tons, December estimated.

Water shipments of Lake Superior iron ore totaled 62,598,836 tons, which have been exceeded only twice, in 1916 and 1929.

Automobile production fell just a little short of 5,000,000 cars and trucks in the United States and Canada, second only to the peak year 1929.

Railroads ordered 49,726 freight cars, 486 passenger cars and 291 locomotives.

NINETEEN THIRTY-SEVEN passed into steel history as a spectacular year. From boom to depression between spring and autumn was the unparalleled record. No recession in steel production has ever come with such rapidity or gone to such depth within so short a span.

Not even in 1920, 1923 or 1929, other "feast and famine" years of recent times, was the drop from peak to low production as drastic as in the past year. In 1920 there was a 26 per cent decline from the March peak to the December low; in 1923 the recession from an April peak to a December low was about 28 per cent, in 1929 there was a 45 per cent drop between May and December, while in 1937 there was an unprecedented decline of about 70 per cent between April and December.

In the 1920-1921 deflation there was a drop of almost 75 per cent from the peak of 1920 (in March) to the low of 1921 (in July), but this decline was of longer duration. Moreover, there was a fairly quick, though not robust recovery, from the low of July, 1921, the total output in the following November having about doubled that of July. The drop in steel output during the year 1921, from the January top to the July low, was about 62 per cent, but as the entire year's production was in a depressed condition the wide fluctuation in that year was not as significant as that of 1937.

Every boom in steel has its natural reaction. While the drop that occurred in 1929 came at the end of a long period of prosperity, and therefore offers no analogy to the current situation, there is a definite relationship between the conditions that created the steel booms of 1920, 1923 and 1937. The 1920 upsurge in business was caused by the release of pent-up peacetime demands after the post-war period of hesitation and adjustment was over, but the fear of scarcity that brought about the high production of that year was created by labor troubles in the coal mines and on the railroads. A strike of railroad switchmen in April crippled the steel mills for months. Advancing wages, higher coal prices and an upward movement of steel prices stampeded buyers into the market in droves. The decline that came in the late autumn was followed by the comparatively mild depression of 1921 and 1922.

In 1923 there was another sharp upswing after almost two years of lean business. There were no important

Depression One Year

OF THE YEAR . . .

Building construction volume totaled $2,910,000,000, which was a moderate gain over 1936.

Exports of iron and steel are estimated for the year at 3,500,000 tons exclusive of scrap, the largest movement since 1920. Scrap exports for the year probably totaled about 4,000,000 tons.

Steel companies expended an estimated total of $225,000,000 for new equipment during the year.

Steel mill employment and payrolls were a record. The year's payrolls are estimated at $975,000,000, a 25 per cent gain over 1936, and the employment peak was 603,000 in August.

labor troubles in 1923, but the steel industry was still feeling the rebound from the strikes of 1922. Higher costs following these strikes made for higher steel prices, with the result that buyers tried to anticipate further advances by ordering steel in large quantities. A serious slump did not come until the final quarter of the year, but it was followed by a year in which steel production fell more than 16 per cent below that of 1923.

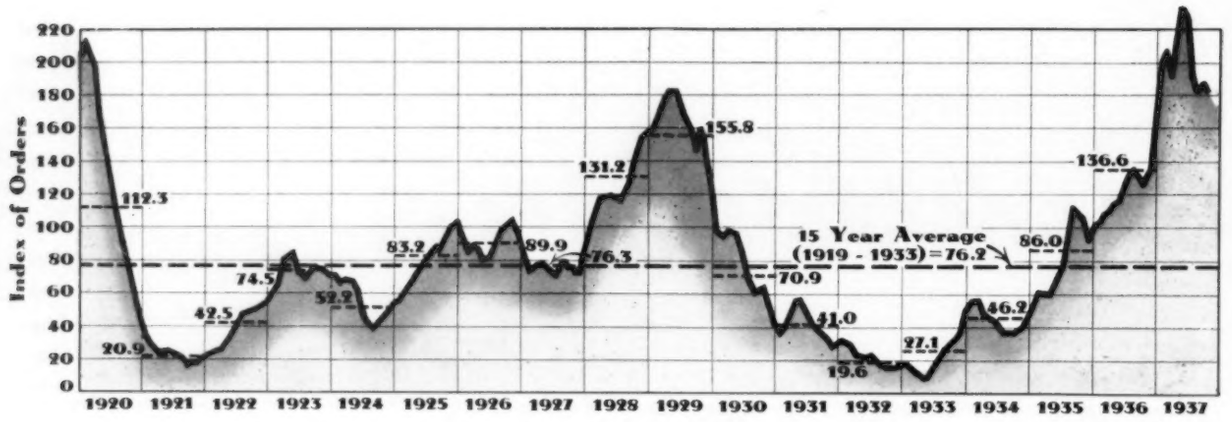
Labor Situation a Vital Factor

THE heavy steel demand of early 1937, like that of 1920 and 1923, came about largely because of long-delayed buying, but the labor situation was the root of a good deal of the panicky rush into the market that caused one of the greatest concentrations of orders the steel industry has ever experienced. The issue of steel mill wages had arisen as early as August, 1936, with a veiled threat of strikes in the background. In November the Carnegie-Illinois Steel Corp. announced a 10 per cent wage increase, which was followed by price advances on steel products. Had this finally settled the matter the history of 1937 steel business might have been written differently, but the labor front was kept in a state of constant agitation by the Committee on Industrial Organization, fostered and encouraged by the Washington Administration.

In retrospect it can be more clearly seen that this labor agitation, by creating fear of scarcity in the minds of buyers, was largely responsible for the tremendous concentration of buying in the early months of the year. As early as January threats of a steel strike were openly made by John L. Lewis if demands to be presented by April 1 were not met; meanwhile the automobile industry and many other large users of steel were being harried by labor controversies. Although automobile production was severely curtailed by long drawn-out strikes in motor plants, the calls for steel from other sources were so insistent that a large volume of incoming business was added to already heavy backlogs.

Steel production had risen to 85 per cent by the time a further wage advance was announced about March 1. This increase, amounting to 10 per cent for skilled workers and from 52½c. to 62½c. per hr. for common labor, together with the adoption of a 40-hr. work-week, with time and a half for overtime, became effective March 16 and was accompanied by another increase in prices. Backlogs and production continued an upward path.

With the settlement of automobile strikes, the motor car companies had to make up for a good deal of lost output as their best selling season was coming upon them, and their steel requirements, piled on top of the general scramble among all other classes of



Machine tool orders hit a post-war peak.

steel users, brought about a topheavy condition, forcing steel companies to strain to the utmost to meet all demands.

The situation was aggravated by the fact that labor agitation did not stop with the granting of two substantial wage increases within a period of a few months. The action of United States Steel Corp. subsidiaries and some independents in signing labor contracts with the Steel Workers Organizing Committee of the Committee on Industrial Organization and the refusal of other companies to sign similar contracts spurred the union organization to greater activity toward bringing the entire steel industry within its fold. A strike against the members of the industry which refused to sign contracts was threatened and came to pass on May 26; meanwhile steel users, apprehensive lest such a development restrict their supplies of steel, had placed more and more orders. The piling up of backlogs and the climb of production did not come to a leveling off period until April, at which time some of the mills were declining to take any more business, all of them sold up through the second quarter and some of them well through the third quarter, although prices for the latter period had not then been announced.

Mills Strained for Output

TO meet the rapacious requirements of their customers steel companies for several months battled against labor unrest, rising costs, insufficient supplies of scrap and coke, and bottlenecks in their own plants such as shortages of blast furnace or open hearth capacity. Even the elements took a hand in making it more difficult for the mills to meet the demands upon them, the Pittsburgh and Ohio River districts having been twice menaced by floods, first in January, which shut down plants in the Wheeling and Cincinnati districts, and again in April, when the consequences were less serious.

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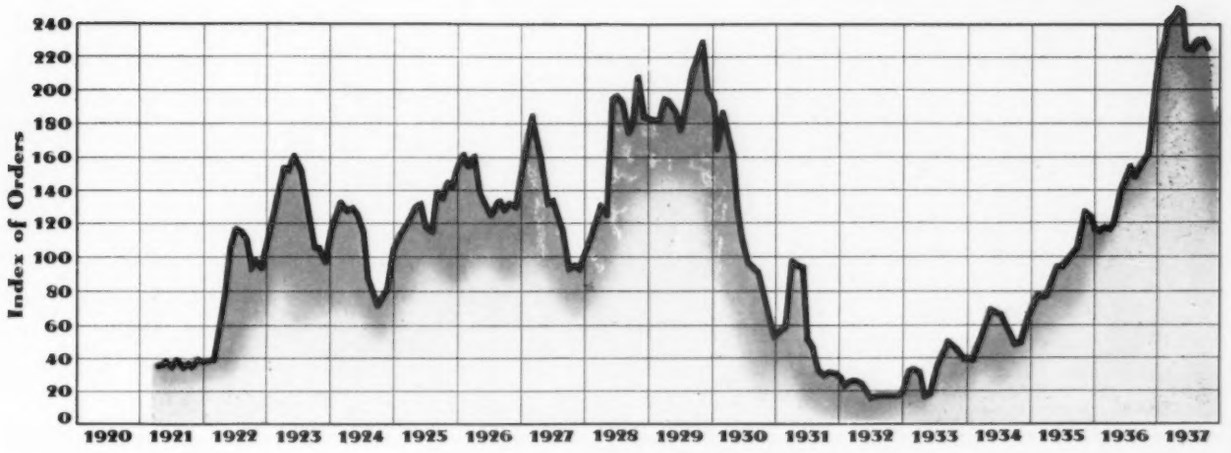
Although the labor situation undoubtedly contributed in large measure to the rapid upswing of early 1937, the ensuing drastic falling off in business has been attributed to a combination of many causes, of which labor was one, but others equally important were the taxing policies of the Federal Government, the general discouragement of business initiative in official utterances at Washington, the confusion caused by the proceedings of the National Labor Relations Board, the fear for constitutional government engendered by the Administration's fight for an enlargement of the Supreme Court, the mounting Government debt, the threats of further legislation that would place greater power in a centralized government at Washington—and above all a supine Congress from which until very recently there was little or no hope for rescue from obeisance to Executive dictation.

The improvement that was logically to be expected during the past year, after a long period of unsatisfied needs, might have proceeded in orderly fashion had it not been for this concatenation of disturbing influences, which first, through fear of scarcity, caused the "feast" in steel business followed by a "famine" of equal intensity.

Nothing is so potent a factor in steel business as the psychology of fear—fear of scarcity or of higher prices drives buyers into the market; fear of an excessive supply or of lower prices drives them out again. In the first half of the year it was fear of scarcity and higher prices that was largely responsible for the extraordinary piling up of orders; in the last half it was fear of an opposite kind that stopped buying and caused buyers to rest on their oars.

President Roosevelt himself, having directly or indirectly encouraged the influences that brought about the short-lived boom of early 1937, sought to curb this upward spiral in late April by open criticism of prices of some commodities, steel, copper and cement in particular. The momentum of the steel industry was such that his statement did not have an immediate effect on production, but it checked the buying wave. The announcement of unchanged steel prices for the third quarter, coming almost immediately after the President's statement, relieved buyers of the fear that prices might go higher. New buying tapered off, deliveries improved, and an orderly and healthy downward adjustment of production might have followed had not the most critical strikes the steel industry has ever experienced followed soon after.

Within a few weeks the plants of the Youngstown Sheet & Tube Co. and Inland Steel Co. were completely shut down, to remain idle for five weeks, while the Republic Steel Corp. was able to operate only on a very much reduced basis and the Johnstown plant of the Bethlehem Steel Co. was twice closed, once by strike and later by dynamiting. At one time about 16 per cent of the industry's capacity was idle. This loss of production forced buyers to become dependent on other sources of supply, although companies that were operating their plants made every effort to discourage diversion of orders. In



Foundry equipment orders reached a high level in 1937.

any event, consumers managed to get along without serious inconvenience, and, as a token of their sympathy for the companies affected by strikes, did not, except to a very small degree, cancel orders.

When the strikes were broken about July 1 and the companies resumed production of the orders they had been carrying on their books, general business was in its usual summer recession, but there were no alarming symptoms and buyers accepted the steel that was shipped to them even when it went beyond their immediate requirements. Under the conditions that had been prevailing, steel consumers did not regard an inventory of 30 or 60 days as excessive; consequently there was no fear of burdensome stocks until the consumption of steel began to decline, as it did by August, bringing the fear, as it was later expressed, that the industry had made "enough steel in nine months to last almost through the year."

Steel Consumption

BUSINESS factors that contributed in a large way to the upbuilding of steel backlogs in the early months of the year were:

The second largest output of automobiles—nearly 5,000,000 in the full calendar year against a peak record of 5,621,715 (cars and trucks in the United States and Canada) in 1929 and a little more than 8 per cent above the 1936 total of 4,616,274. Significantly, however, about three-fifths of the year's output came in the first six months.

Railroad orders for cars and locomotives were less than in 1936, but were concentrated in the first few months of the year. Freight cars ordered totaled 49,726, according to *Railway Age* computations, against 67,544 in 1936, but 55.9 per cent were ordered in the first three months and 91.3 per cent in the first six months. Of the 486 passenger cars bought, against 306 in the previous year, 79.4 per cent were ordered in the first three months. Only 291 locomotives were bought compared with 533 in 1936, but the bulk of this business (78.5 per cent) came within the first six months. While railroad equipment buying as a whole did not equal that of 1936 and was far below that of 1929, when 124,140 cars were placed, the rush in the early part of the year contributed in no small degree to the steel boom.

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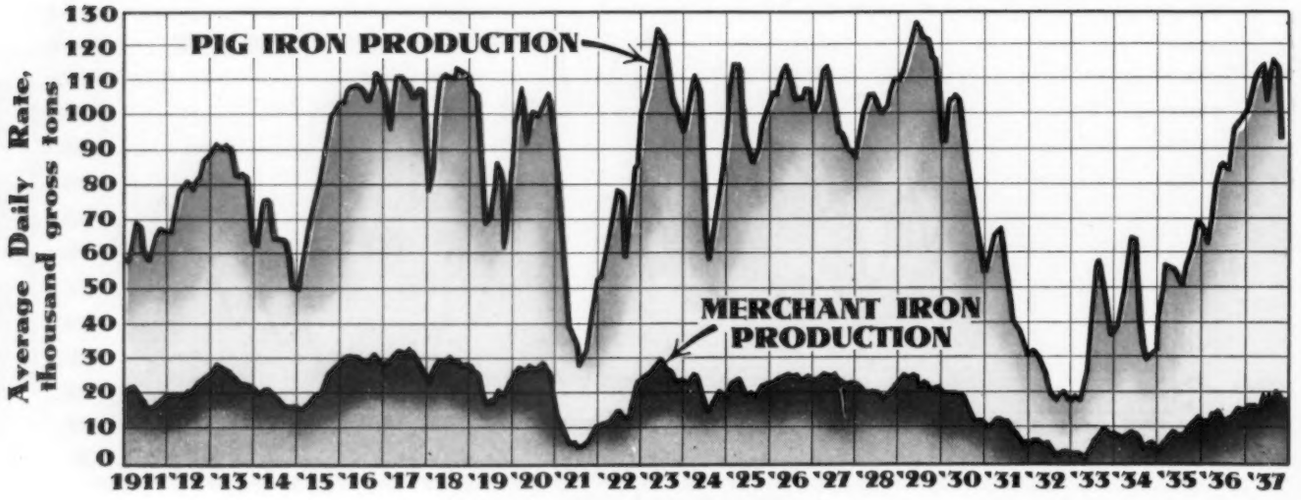
Building construction made a less conspicuous record than either of the other two leading outlets for steel, but here also a large part came in the first quarter—some of it in the form of fabricated structural shapes and plates being a hangover from late 1936. Total expenditures for building construction in the year were about $2,910,000,000, which was a gain of only $234,705,000 over 1936, the heaviest gain being made in industrial buildings. In the first 10 months, bookings of fabricated structural steel, according to compilations by the American Institute of Steel Construction, were 1,381,381 tons against 1,320,867 tons in the corresponding period of 1936, a gain of only 4.4 per cent. Fabricated plate orders, however, at 484,036 tons in 10 months of 1937 rose rather sharply over the 392,554 tons in the like period of 1936.

No small factor in steel activity in early 1937 was the large export trade. Based on actual figures for 10 months, the estimated total of pig iron and steel shipments abroad is 3,500,000 tons, the largest movement since 1920. Pig iron exports made up about a quarter of the total, still leaving a sizable amount of semi-finished and finished steel. Meeting this demand, which was attractive to the mills since much of it brought prices higher than were ruling in the domestic market, put an additional tax on capacity because export orders were largest when domestic requirements were at their peak.

Other important consumers of steel also took large quantities. When the final figures for the year are completed it probably will be found that production of tin plate broke all records; the oil industry placed a fairly large amount of business in pipe, one pipe line order having amounted to 65,000 tons; the farm implement and machinery industry was outstandingly busy throughout the year and probably surpassed its average for many years in consumption of steel; the machine tool industry, which experienced one of the heaviest demands in its history, was a large user of pig iron and special steels; many lines of household equipment, refrigerators in particular, were breaking previous production records during the first half and were large consumers of sheets and strip.

What of the Future?

DURING its most active period the steel industry learned a new lesson as to what it is capable of producing and what the country is capable of consuming under prosperous conditions. Underlying conditions have changed psychologically but not fundamentally. There is still



Pig iron production did not reach previous peaks.

a latent demand for steel of large proportions. On every hand are indications that the deficiencies created through several lean years have not been satisfied by less than two years of rehabilitation; yet the elements of confidence that are necessary to sound business are found to be lacking as 1938 is ushered in.

For the short term—the first quarter of the new year at least—the recovery from the drastic decline of the last few months of 1937 is bound to be slow and halting, but the year as a whole may give a fairly good account of itself, though expectations do not point to as good a year as 1937 was as a whole. Much depends upon the developments of the immediate future—the settlement of the issue of wages and other labor conditions that will come as a result of the negotiations between some of the steel companies and the Steel Workers Organizing Committee, scheduled to start on Feb. 7, and the effect of this settlement, whatever it may be, on price policies; the question of relief for the railroads to lift them from the brink of financial disaster and bring them back into the market as large buyers of steel and equipment; and the acts of the Federal Administration, as shown by the will of Congress, in altering some of the taxing and other policies that experience has shown have placed a brake on business initiative. Once these matters are out of the way the outlook for the steel and related industries will be more encouraging.

Steel Output Third Largest

DESPITE the low production of the final quarter, the total output of open hearth and bessemer steel ingots in 1937 totaled about 49,500,000 gross tons (December estimated), exceeding all previous years except 1928 and 1929. At no time during the year was it expected with any degree of confidence that the year's total would surpass that of 1929, which was 54,312,279 tons, but until the severity of the last half slump became apparent it was assumed that 1937 would take second place with ease. The 1928 production was 49,865,185 tons of open hearth and bessemer steel, and, although official December figures are not available at this writing, the 1937 total was expected to drop somewhat below that of 1928.

Pig iron production, excluding charcoal iron but including ferromanganese and spiegeleisen made in blast furnaces, totaled about 36,800,000 gross tons (December estimated), an amount that has been exceeded in four of the post-war years whereas steel production has been exceeded only in two. The record output was 42,286,000 tons of pig iron, ferromanganese and spiegeleisen in 1929. Last year's pig iron total was almost 21 per cent above that of 1936, which was 30,618,797 tons, while steel ingot output was less than 6 per cent over that of 1936.

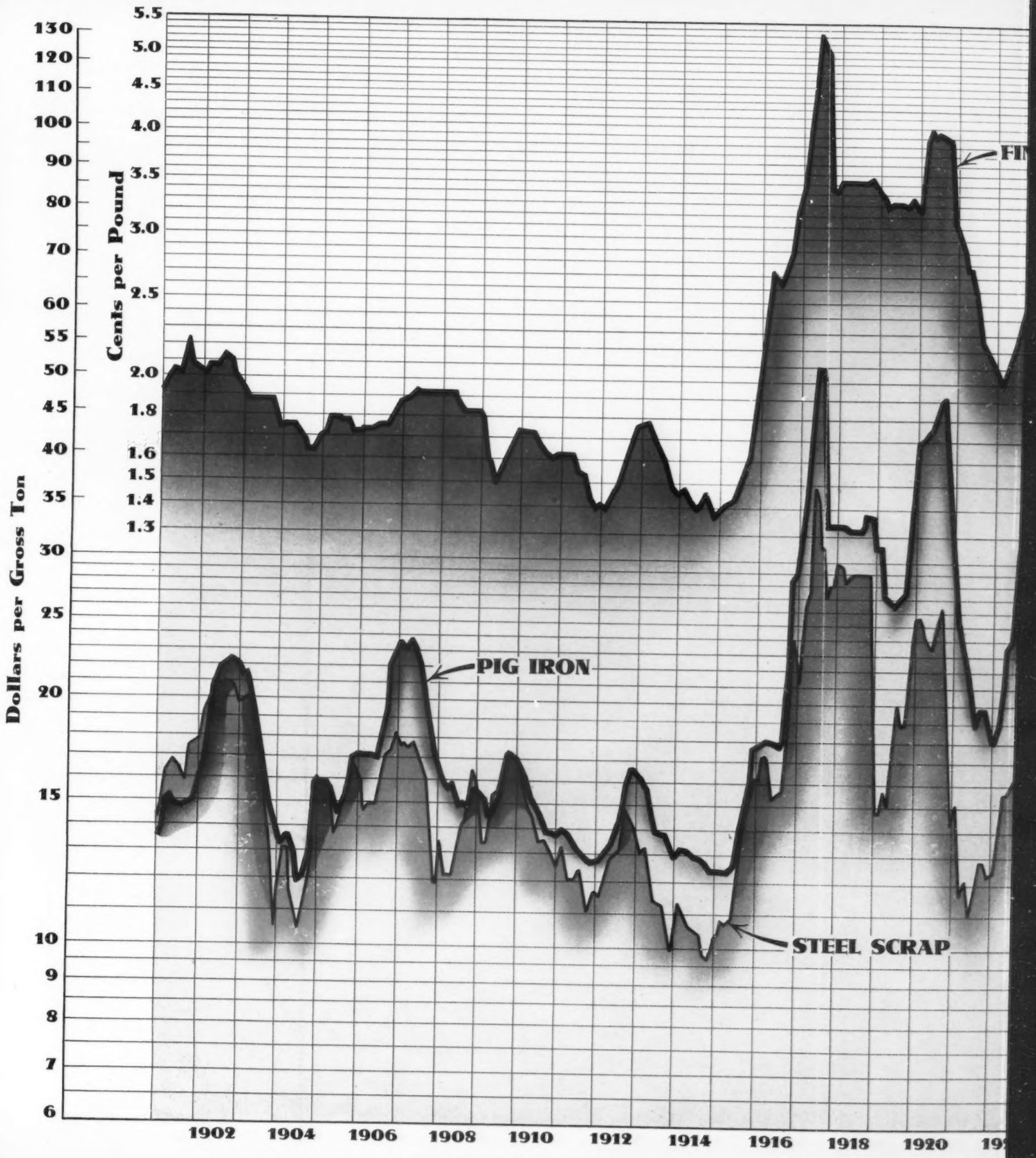
Almost a record was achieved in movement of Lake Superior iron ore. Had ore shipments continued throughout the navigation season at the pace that was set in the early months, the high totals of 1916 and 1929 might have been eclipsed. The 1937 movement by water was 62,598,836 tons, while the rail shipments are estimated at 600,000 tons additional. The all-time record for water movement was the 1929 total of 65,195,595 tons; 1916, with 64,734,198 tons, was a close second, and 1937 came third. The slump in steel production in the past several months has resulted in the building up of large stocks of ore, the total at docks and in furnace yards as of Dec. 1 having been estimated at 40,395,000 tons, compared with 35,378,068 tons on the same date in 1936. Unless there is a sharp revival in steel production, the amount remaining at the opening of the 1938 navigation season will be abnormally large, probably much above the 14,632,038 tons that was in stock at the opening of the 1937 season. According to present estimates, the 1938 water movement will not exceed 45,000,000 tons.

Price Movements

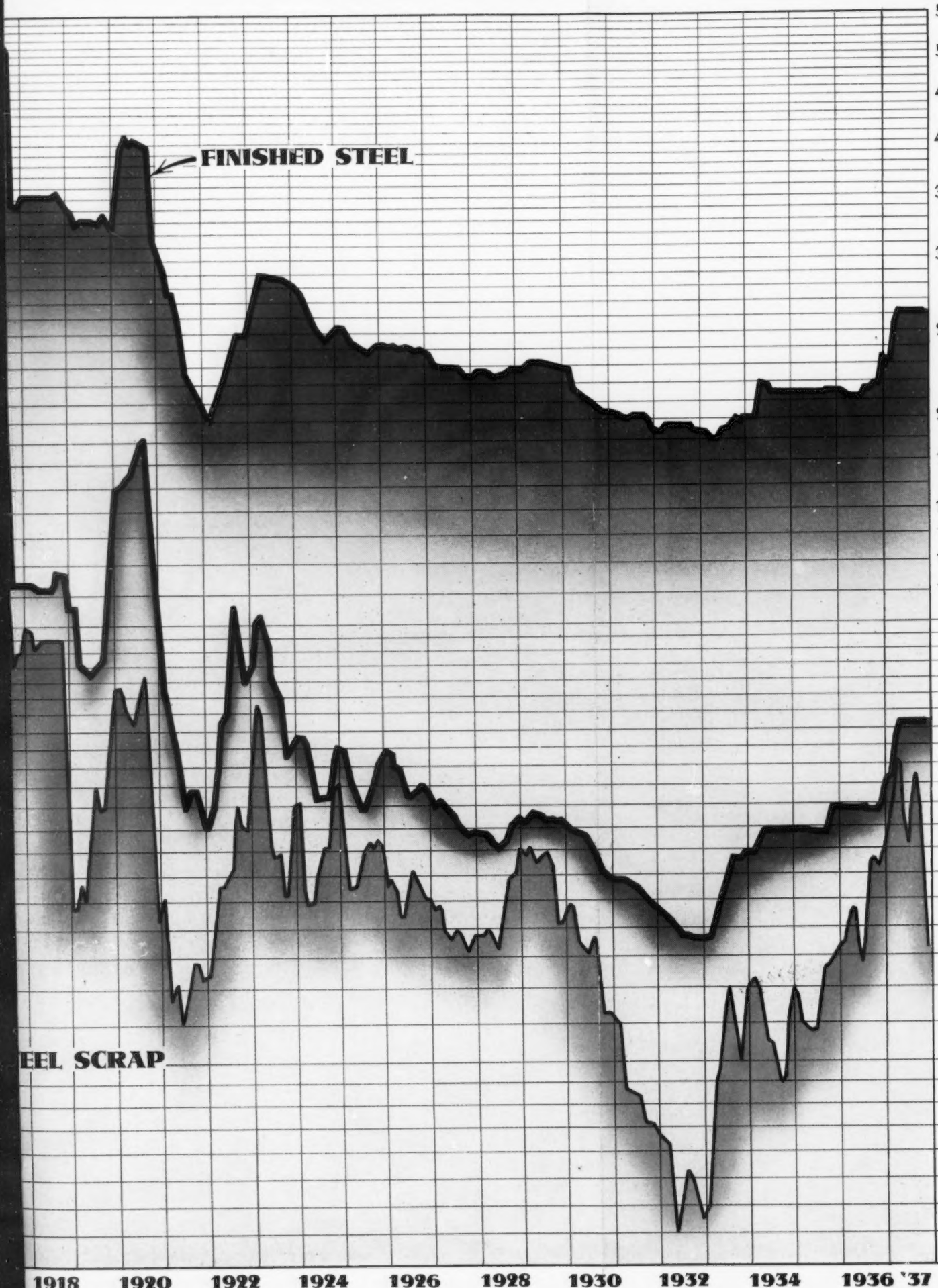
THE price advances that were announced early in March on nearly all steel products, coming on top of those that were put into effect late in 1936, brought the average level of steel prices (as shown by THE IRON AGE composite price) to $10.42 above the low point of 1936 and $14.76 a ton above the depression low, which was in April, 1933. The high point of 1937 was $11.52 above the high level of 1929, but meanwhile labor costs had risen fully 20 per cent.

Pig iron prices did not move exactly in unison with steel, but there were two advances totaling $3 a ton, which brought THE IRON AGE pig iron composite price $4.52 a ton above its low of 1936, $9.69 above its depression low and $4.54 above its highest level in 1929.

Scrap price movements during the



Price Curves of Finished Steel, Pig Iron



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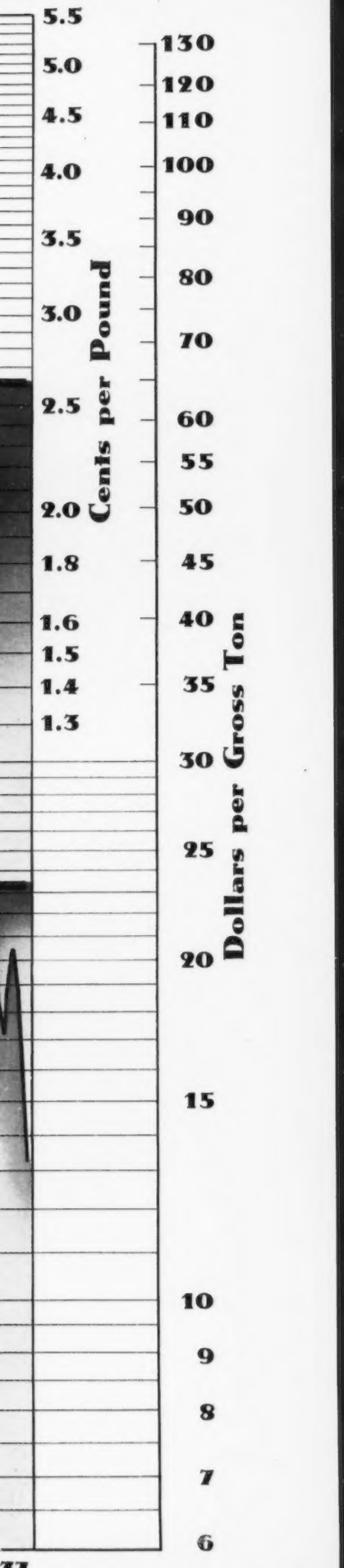

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year were highly erratic. In the first week of January the average price, as shown by THE IRON AGE composite, was $17.92. There was a steady advance week by week until the year's maximum of $21.92 was reached in the final week of March, the highest since 1923. This level was held for only two weeks, when a gradual decline set in that continued without interruption until the middle of June, by which time a low for the first half of the year of $17.08 had been recorded.

Immediately upon the resumption of production at steel plants that had been shut down by strikes, the scrap market started to move up again, but another halting place was arrived at in late August, when a secondary peak of $20.58 (THE IRON AGE composite) seemed to point to an active fall period for the steel industry. Before the beginning of September, however, signs that steel production might decline rather sharply were appearing, and steel scrap again started on a long decline which was not halted until November. In this period there was a progressive drop amounting to $7.66, but the low point, $12.92, was exactly $9 below the year's peak. Not in many years has there been such a wide swing in scrap prices; in 1936 the difference between high and low was $5.09; in 1929 it was $3.50.

Scrap was one of the major problems of the steel industry in 1937. In the spring, when the steel plants were straining for maximum output, the price of scrap was high and the supply of good material was none too plentiful. At times there were fears of an actual shortage, which brought into existence a movement among some of the steel and foundry companies for legislation that would place a curb on scrap exports, which were running heavily to Japan in the early part of the year and later in large tonnages to Great Britain and other European countries. The efforts of the scrap consumers were well organized under the name of the Independent Iron and Steel Producers Committee on Scrap, which opened offices in New York and extended its activities to Washington, where bills were introduced in Congress on which hearings may be held at the regular session beginning this month.

The export of scrap became of spectacular popular interest. Newspaper headlines and moving pictures made the public conscious, possibly for the first time, of the economic importance of this raw material not only to our own steel industry but to the rearmament programs of Japan and the European nations. Some Government officials, notably Secretary of State Cordell Hull, made known their opposition to restrictive legislation, and the situation, as it may eventually be presented to Congress, was complicated by efforts by some members of Congress to include pig iron, steel and other raw materials that could be used for armament purposes in any legislation to be considered.

While all of the agitation was going on, the movement of scrap out of the country was unceasing. Although official figures have not yet been issued for the full calendar year, it is indicated that the 1937 outgo was close to 4,000,000 tons. The 10 months' total was 3,520,812 tons, of which Japan took 1,868,000 tons. The 1937 exports were approximately double those of 1936.

New Steel Capacity

Expenditures for steel mill equipment in 1937 are estimated at about $225,000,000. A considerable part of this went into mills for the continuous rolling of sheets, strip, skelp and light plates, with auxiliary cold reducing units for the making of cold reduced tin plate. Four large mills that were projected in 1936 have been completed within the past year. These are the 98-in. mill of the Republic Steel Corp. at Cleveland, the largest of that type that has been built; the 56-in. mill of the Bethlehem Steel Co. at Sparrows Point, Md., and the 48-in. mill of the Tennessee Coal, Iron & Railroad Co. at Fairfield, Ala., and the 96-in. mill of the Jones & Laughlin Steel Corp. at Pittsburgh, which went into production early in the year.

The Carnegie-Illinois Steel Corp.'s 80-in. mill at its new Irvin works will be completed by the middle of this year. No other mills of this type have been announced, but when the Irvin mill is in production the country's capacity in wide strip and sheets by the

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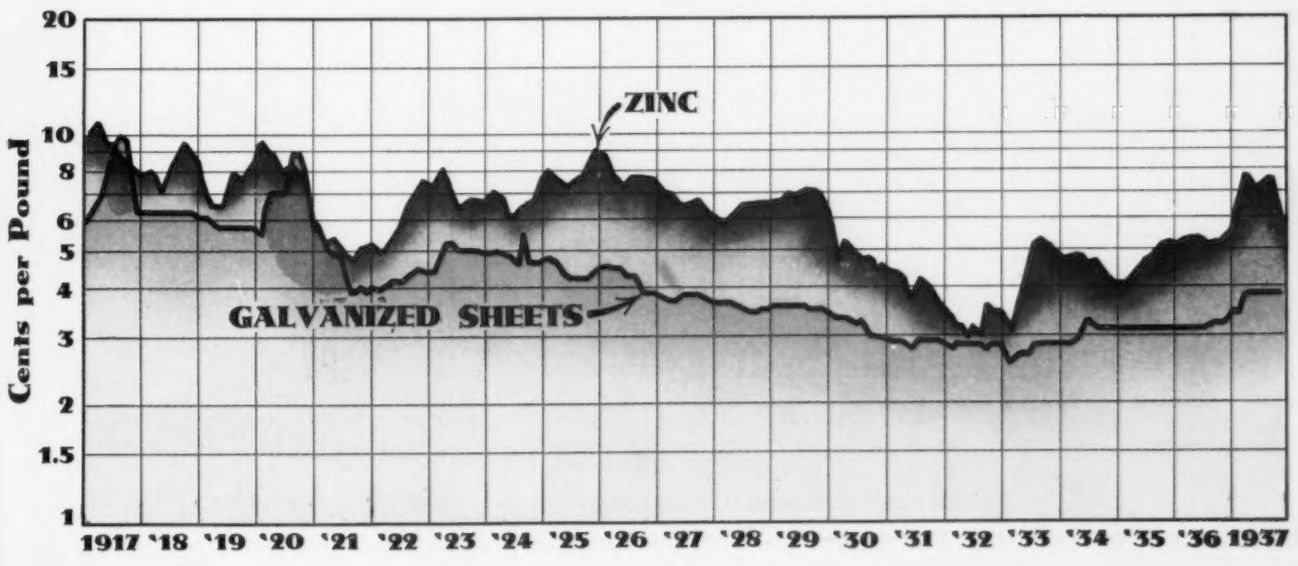
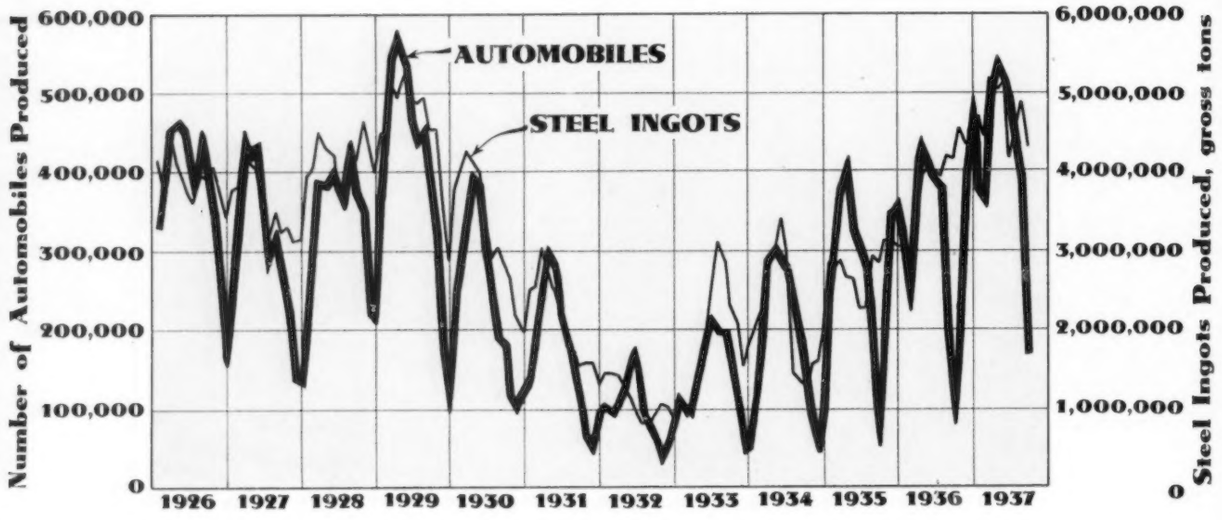
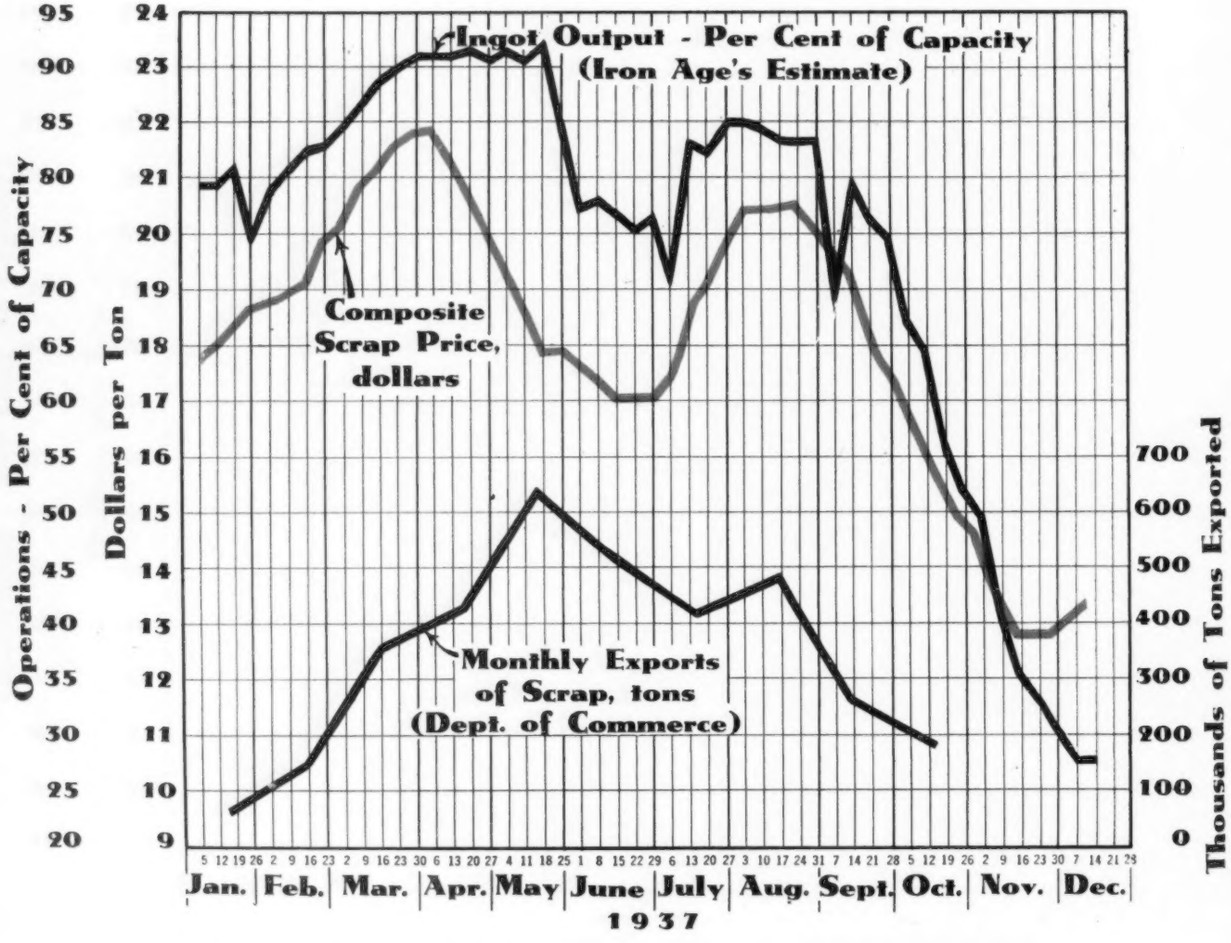
The spread between prices of galvanized sheets and zinc has widened since 1932.

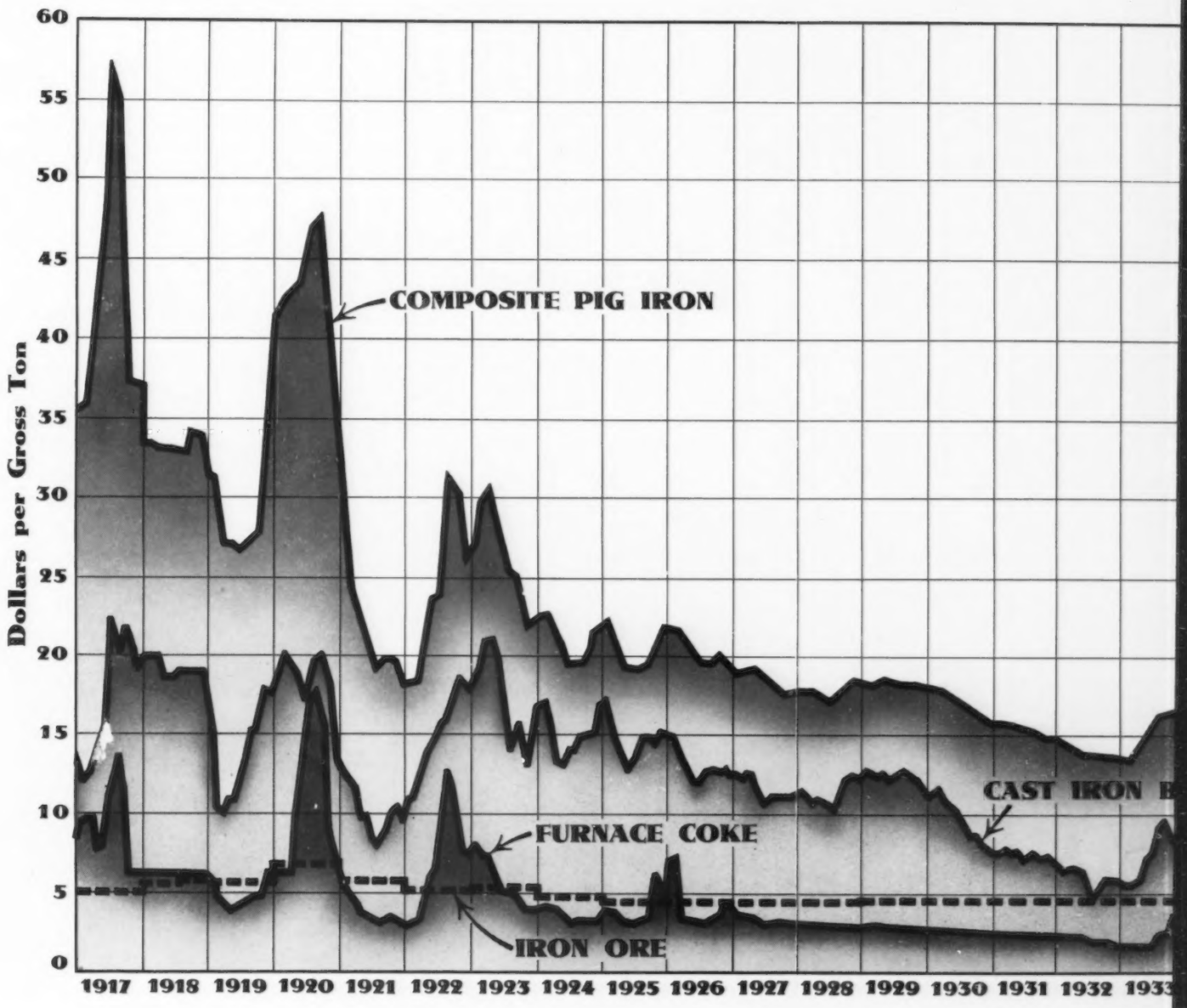




A comparison of the record of automobile production and steel ingot production over a period of years.


Ingot Output - Per Cent of Capacity
(Iron Age's Estimate)
Composite
Scrap Price,
dollars
Monthly Exports
of Scrap, tons
(Dept. of Commerce)
Operations - Per Cent of Capacity
Dollars per Ton
Thousands of Tons Exported
95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20
24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9
700 600 500 400 300 200 100 0
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1937

The scrap price record during 1937 as related to steel ingot production; also volume of scrap exports during the year.



Pig iron prices have
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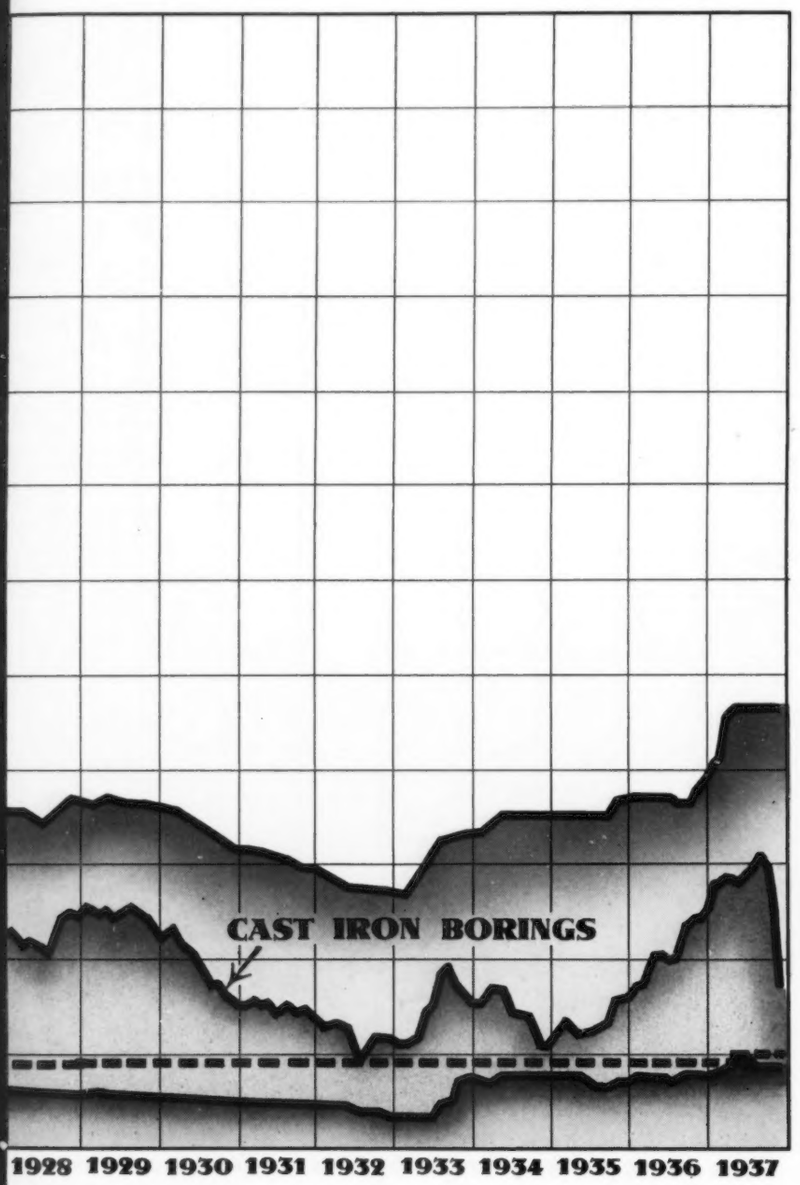
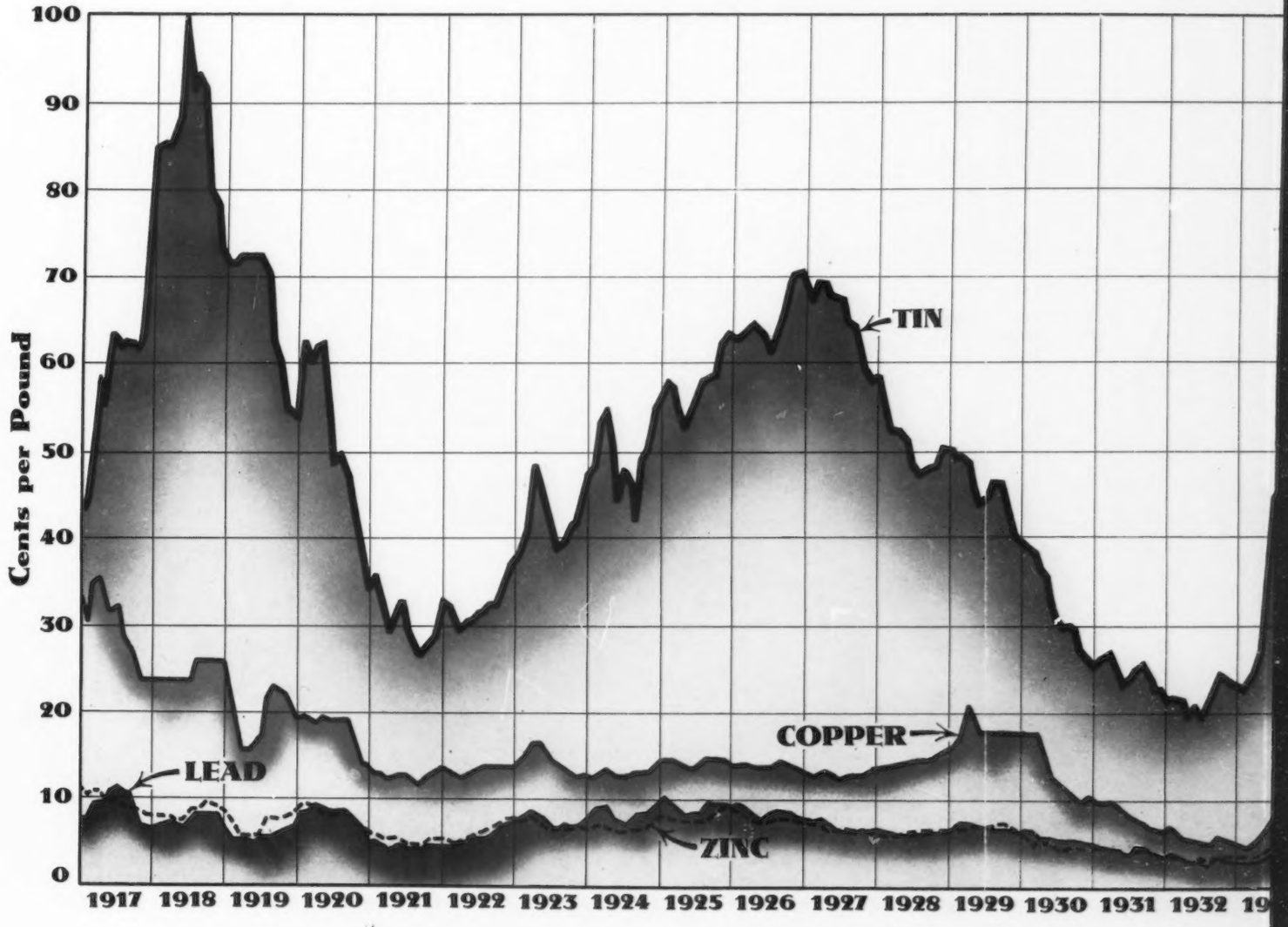


Pig iron prices have shown strength throughout the past year. Moderate rises occurred on iron ore and coke, while cast iron borings followed the erratic course of the scrap market in general.

UNIV. OF MICH.



Nonferrous metals
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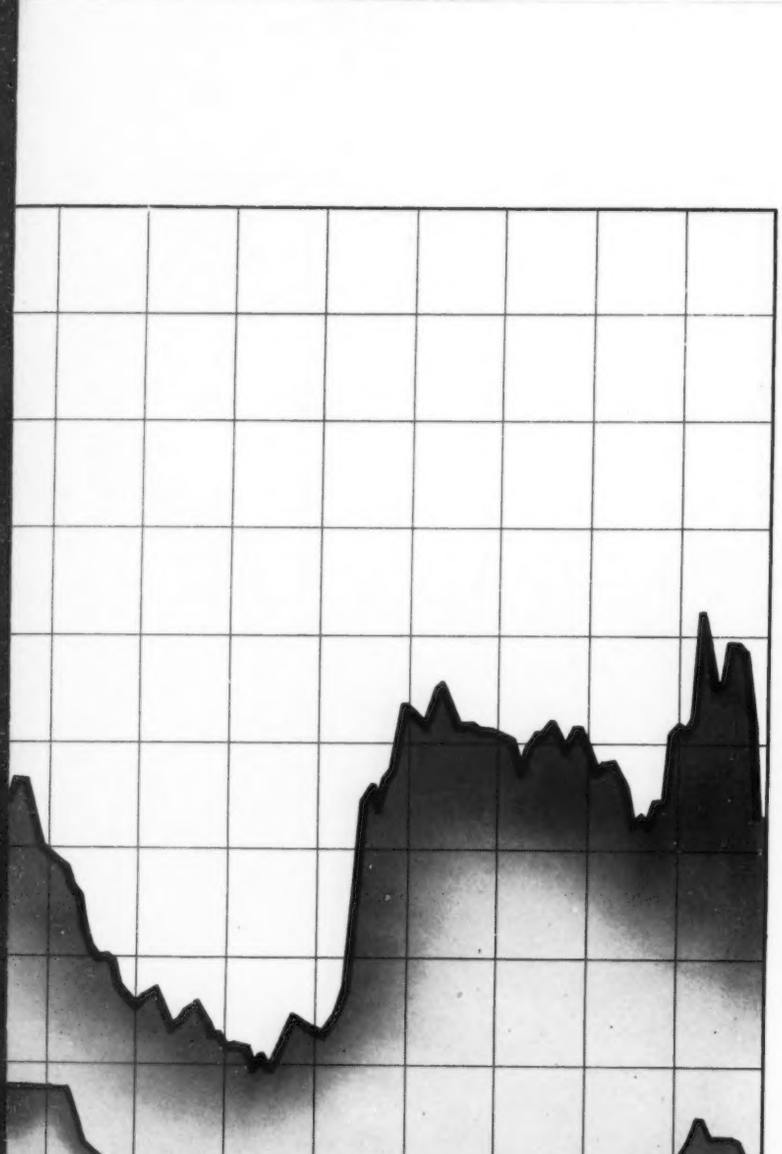

Nonferrous metals showed marked strength during the early part of 1937, but declined rather sharply in the last half.

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continuous process will have been raised to about 13,000,000 tons annually. Considerable of this tonnage, however, will replace older type units which eventually will be scrapped. This is particularly true in the tin plate branch of the industry where cold reducing is rapidly displacing the hot mill method.

Although new appropriations for 1938 will not be as large as those of 1937, actual expenditures against previously authorized projects will be almost as large this year. The installations of rolling equipment that have been made require the rounding out of auxiliary facilities and the elimination of bottlenecks that were brought to light in the rush of last spring. Elsewhere in this issue details are given of equipment installed in 1937 and that which is contemplated for 1938.

Employment at All-Time Peak

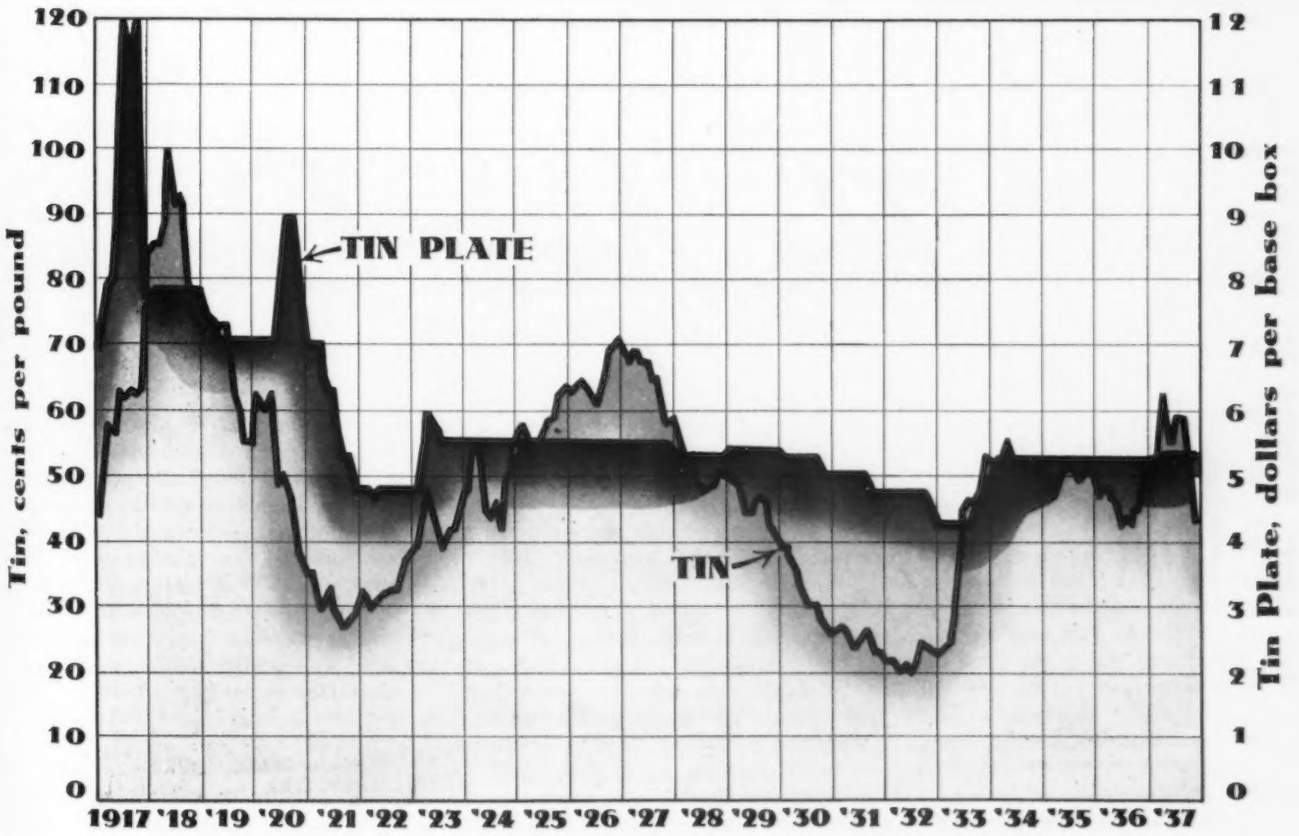
PAYROLLS of the steel industry established a new record during 1937, according to figures compiled by the American Iron and Steel Institute. The year's payrolls are estimated at about $975,000,000, a gain of about $200,000,000 or 25 per cent over the $758,060,000 paid to steel mill workers in 1936. The wage increases that were inaugurated in November, 1936, and in March, 1937, brought hourly rates up to an average level of 83c., the highest ever attained in the steel industry. In addition, wage payments at time and a half for overtime over 40 hr. a week swelled workers' pay envelopes during the period when the mills were running at a high rate of production. Vacations with pay were granted to 300,000 steel workers during the year at an estimated cost to the companies of $12,000,000.

Despite the mechanization that has been in progress for some years, the industry employed the greatest number of workers in its history. The peak was 603,000 in August, 1937, but even after that date, when production was beginning to slow down, the number employed was greater than at corresponding periods in 1936. In October, for example, the number employed was 586,000, only 3 per cent less than the September total, although ingot production in October was 21 per cent below that of September.

WHERE STEEL WENT

A CUSTOMARY feature of the Annual Review Number of THE IRON AGE—the compilation of statistics on the distribution of finished steel products by consuming industries—has been omitted from this issue for later publication at a time when steel companies will be able to give complete figures on 1937 shipments instead of being required, as in the past, to estimate December and sometimes November shipments.

In the interest of greater accuracy in the presentation of these figures, which have been a regular feature of THE IRON AGE since 1922, it was believed to be desirable to postpone publication. Indications are that the complete figures will be available for publication in late February or early March.



Tin prices rose and fell sharply during 1937, while the tin plate price recorded one advance—from $4.86 per base box, Pittsburgh, to $5.35.

Alfred Cook

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"EQUAL Justice Under Law." This is the inscription on the new Supreme Court building. Its truth will be demonstrated in the coming years.

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The New Deal

AS the new year enters upon an uncertain march of destiny it sees the New Deal shift its strategy. Faced with a serious business slump whose degree and length cannot be surmised, the Washington Administration has called a sharp check, but far from a complete halt, on attacks on private enterprise. Just now it is urging cooperation. But at the same time the Administration is charged with harassment that is an obstacle in the way of gaining confidence of business, highly necessary to getting back to the road of industrial recovery and employment which have been so violently diminished since the terrific $25,000,000,000 stock market crash last October.

There is a largely prevailing fear that the softened attitude of the New Deal toward industry not only is qualified but that it is merely temporary—an expedient to pull the Administration out of the "recession" hole in which it finds itself. Concern is felt that the quarterback is making a false gesture to catch the defense off guard. There exists the suspicion that, once the right turn has accomplished its purpose, it will be followed by another shift to the left end and a run made for the unchanged goal—the goal of futile and enormously expensive industrial regimentation and economic planning against which blame is directed by New Deal critics for the business nose dive. This critical sentiment has it that the New Deal in no way has switched from its objective of widespread Federal control over the economic structure of the nation and that the purpose of its zig-zag course is manifest. Its confusion in policies, given to rapid-fire changes, is held to be partly due to bewilderment on the part of the Administration itself but that, while these are only indefinite means, the end sought is Federal mastery over industry.

Confidence-Shaking Policies

To support their position, critics point to confidence-shaking policies applied by the Administration on the one hand while wooing private industry on the other: its "anti-trust" drives

on "big business" and "monopolies," broad-scale investigations of industrial groups, with threats of expanding them; over-playing the part of organized labor under the one-sided Wagner Act; growing intrusion of Government competition with private business. Sharp slaps are made at large industries, such as steel, cement, copper, aluminum, etc. Cries of monopoly and high prices are raised against them. Seeking to wash its hands of blame, the Administration points its fingers at these and other large industries and says they are responsible for the steep business decline. Their prices are too high, say Administration sources. Hints that grow into almost outspoken demands come forth that prices be slashed, prices whose rise have not been so high as the public is led to believe. And prices which most certainly have been forced up because of Administration insistence on high wages and short hours and heavy taxation. Unfortunately the problem of short hours has been ruthlessly solved, to the great cost of labor and industry, again in or getting into red, by what the Roosevelt Administration calls the "recession."

Despite the criticism of the New Deal by business and the criticism of business by the New Deal, each suspicious of the other, there is general recognition on the part of both that greater cooperation between them is necessary if recovery is to be achieved. The tenor of the day is luckily toward participation as is seen by White House moves and conventions of business groups as well as by individual business leaders. Whether either the Administration or industry—at least large sections of industry—can get as much "cooperation" as is desired obviously they must come nearer than they are now to the "era of good feeling" which the President bespoke in his second inaugural address on the dreary, drizzling day of Jan. 20, 1937, an era that came to an abrupt and swift end 16 days later when, exceeding all his previous startling proposals, he shocked the nation by asking Congress for authority to pack the Supreme Court. In the euphonious terms of the Administration it asked for authority to "reorganize the Federal judiciary."

"Court Packing" Hit Confidence

It is perhaps accurate to say that loss of business confidence in the President reached its high tide by this "court packing" plan and has never been regained since. It was immediately interpreted as signifying a White House effort to control the judiciary, just as it had controlled Congress, thus reducing the Government and with it business, finance, labor and agriculture, solely to executive control—one-man control to fascism. The Administration, riding high on its unprecedented re-election vote, even submitted a ready-prepared bill to accomplish its Court packing plan. But, to the deep chagrin of the President, his naive implication that he had a mandate to "reorganize" the Supreme Court enraged a large group in Congress among his own followers and the reaction from the country was also definitely disappointing.

The proposal developed the hottest fight in the Senate that has raged in it since the Civil War and finally was crushed with a scorching report from the Senate Committee on the Judiciary that was the most devastating criticism ever made of a President of the United States, a memorable document that will mark a highlight of American history. It is significant, too, that there were evidences of business decline on the heels of the Court packing plan. It gave business the jitters.

The proposal came near tearing the New Deal asunder. And it undoubtedly marked the decline of Presidential prestige. Likewise it developed a degree of independence in a hitherto rubber-stamp Congress, though while this independence has grown as evidenced by the special session of Congress just ended, it would be absurd to say that Presidential influence is not still strong. For even after putting Senator Black of Alabama on the Supreme Court Mr. Roosevelt's prestige in Congress still is strong, because he is President, because of political reasons, and, bluntly, because of the vast spending power which a meek Congress has given him.

But to the growing independence of Congress—itself a notorious squanderer of taxpayers' money—was exhibited at the special session because members heard in no uncertain terms from their constituents when they returned home after the regular session. They came back to Washington at the beginning of the special session, Nov. 15, with demands to check the recession, and to put a damper on the wild spending orgy.

Seeing a rapid and widespread letdown in industry and employment, and fearing a major depression, a Congress which heretofore voted billions in appropriations at a Presidential nod suddenly became "economic-minded." With loud complaints from business ringing in their ears, large groups, among them Administration leaders, insisted on quick tax relief for busi-

and Business

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BY L. W. MOFFETT
Washington Editor, The Iron Age

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Never before in our history has the fate of business and of labor been so centered in Washington as at present.

ness, some for outright repeal and others for sharp reduction in undistributed profits and capital gains taxes for which they had previously voted so easily. With an election near, many of these members of Congress realize that if they are to save their political hides there must be recovery and that an essential to recovery is the need of profits and surplus for industry and more thrift in Government. In fairness, other members of Congress, while not overlooking the political portents, were anxious to give industry tax relief because they finally discerned that the present New Deal taxes are intolerable.

Congress Wrestles with Legislation

The Administration also professed to have become economic-minded and is on record in favor of modifying, though not repealing, the undistributed profits and capital gains taxes and is again talking economy. But it held out against pressure in and out of Congress for action on tax relief at the special session. It will be one of the first moves at the regular session, however, and to this end the House Committee on Ways and Means, after hearing Treasury experts, is whipping a tentative draft of bill into final form. It will not go as far as industry desires but it will provide substantial relief, especially for "small business." It is possible the Senate, under the leadership of Senator Harrison of Mississippi, chairman of the Finance Committee, will go farther than the House. For Harrison, less chummy with the White House than he was before being defeated as majority leader upon the death of the late Senator Robinson, has differed sharply with the Treasury program, which he holds does not provide the necessary relief.

Instead of proceeding with tax relief at the special session the President asked for legislation on crop control, wages and hours, TVA regional planning and Government reorganization. His recommendations started cat and dog fights in both branches of a Congress that came near doing nothing. Reflecting alarm over the "recession," a housing bill was thrown in by the Administration as an "extra." Even after enactment, however, there is doubt as to any early stimulating effect it may develop. Congress is wrestling with incomprehensible political farm bills, which, mirroring a lapse in the so-called move for economy, will cost the country considerably more than $500,000,000 a year. The Senate bill having passed Dec. 17, it and the House bill will have to be fitted together in conference for final enactment at the regular session.

Marking the second major defeat of the New Deal for the year—crushing of the court packing plan having been the first—the wage-hour bill, under the hot opposition of the Democratic South, was blocked in the House just as the Senate passed the farm bill. Defeat of the wage-hour bill by members of its own house from the South stunned the New Deal. It also was a setback for the CIO, though not essentially a major setback. For CIO support of the bill was only mild and perhaps was occasioned by reason of opposition to the bill, as drafted, by the AFL. It does not follow that defeat of the bill meant victory for the AFL, however, for the latter appeared to be only a slight influence on the legislation one way or the other. Passage of the regional planning bill, against which public utilities have directed attack, is expected at the regular session but it may be toned down somewhat now that the Administration is seeking their aid to revive recovery through a large construction program.

Public utility leaders who conferred with the President indicated they had re-established an *entente cordiale* and gave promise of cooperating by way of early entry upon a huge delayed construction program with less fear of Government competition than had been felt before.

White House Rapprochement

At least the psychological effect from these conferences and the generally more lenient position of the Administration lent the hope that the conversations will be translated into practical results by bolstering up the country's economic structure. The shift in the New Deal position, however, was preceded by the warning of the President in his message convening the special session that if private enterprise did not respond to Administration encouragement the Government must take up the slack. Whether this was or was not a bogey man, the admonition gave a chill to business interests who envisioned further Government control, higher rather than reduced taxes, and another heavy splurge of spending heaped on the present unprecedented national debt of $38,000,000,000.

The mollifying influence of White House - business rapprochement has been offset to a considerable degree by Administration "drives" against big business. There is anti-trust prosecution, such as aluminum, oil, and Western Union-Postal suits, with threats of others. There are Department of Justice and Federal Trade Commission studies under way to tighten anti-trust laws to break down so-called monopolies which are pictured as ogres holding up prices and as responsible for the business slump.

Attacks on Prices

Steel, cement, copper and aluminum have been singled out in the durable goods field for high price activities. They first met with Presidential condemnation last spring and the Administration has followed through in attacking them either by prosecution or by reports assailing them. Inspired by Secretary of the Interior Harold Ickes, who kicked about PWA steel bids, the President had the FTC report—which it did in bitter terms—on so-called collusive bidding and identical prices in steel and other products. The basing point system was held largely responsible for identical bids. The President turned the report over to the Department of Justice for whatever action it saw fit to take.

After long delay Attorney General Cummings in April said the Department of Justice investigation on so-called collusive steel bids had not produced sufficient evidence to make advisable proceedings in court under anti-trust acts "as now construed by the courts." This was a leverage to suggest wide opening of the anti-trust laws for amendment and the Department of Justice is proceeding to that end now and was given a further spur to do so by the President in his opening message at the special session.

Subsequently the President, taking another twist in the anti-trust attack, said "monopolistic" practices are the cause of the high cost of living and he ordered the FTC to investigate and make an early report. Some think it may incorporate the principles of the O'Mahoney Federal licensing bill and possibly the principles also of the Wheeler anti-basing point bill, the latter designed to prohibit the basing point system and substitute the FTC's f.o.b. mill plan. Buttressing this demand for application to all industries are the present anti-basing point cases the FTC is pushing against the cement and cast iron soil pipe industries, the former using the multiple and the latter the Birmingham-plus system.

The steel industry and the White House came into close contact over the

labor situation the past year which was heralded in with a rash of CIO sit-down strikes in the motor and other industries, followed by "stand-up" but violent strikes in steel plants.

One of the early 1937 White House callers was Chairman Myron C. Taylor of the United States Steel Corp. He conferred with the President on Jan. 10 and it is reported that the labor situation was discussed, although Taylor told newspaper correspondents, "Just say we talked things over generally." He made subsequent White House calls. There was never confirmation of the report that these calls were connected with a later meeting at the Mayflower Hotel between Taylor and John L. Lewis, CIO head, precedent to the Carnegie-Illinois recognition of the SWOC.

President Roosevelt had shown increasing concern over the labor situation and undoubtedly took an active part in it backstage, though studiously seeking, with certain notable exceptions, outwardly to keep out of the picture. The first such exception, strangely enough, was an oblique rebuke he administered to Lewis, of all people, whose CIO contributed more and did more intense campaigning for the re-election of Roosevelt than any group. Irritated at Lewis' demand for Presidential intervention in the General Motors strike, the President at a press conference said, "Of course, I think, in the interest of peace, there come moments when statements, conversations and headlines, are not in order." The pointed observation was matched later by the President's "Plague o' both your houses" when mediation efforts to settle independent steel strikes broke down.

It was a little later that Lewis roared about the possibilities of war between capital and labor, adding that the motor strike was only a "sideline engagement, far to the left" with the organization of the steel industry as the main objective of CIO. Ensuing were the violent SWOC strikes at independent steel plants when they declined to follow the Steel Corporation lead in signing an SWOC contract.

While the Jones & Laughlin Steel Corp. and four other industrial companies were fighting the Wagner Act in the Supreme Court last February the steel industry got into a tangle with Secretary of Labor Perkins over the Walsh-Healey Government Contracts Act and was supported by the Navy Department. The difficulty vanished in March, however, when the steel industry shifted to the 40-hr. week.

Shift to 40-hr. Week

Soon after—in the latter part of March—Administration circles became apprehensive over the economic situation. Chairman Marriner Eccles of the Federal Reserve Board, Secretary of Commerce Daniel C. Roper and Edward F. McGrady, then Assistant Secretary of Labor, warned against the upward spiral of wages and prices and their inflationary implications unless controlled. Again steel prices were brought into the discussion and two weeks later they, together with prices of other durable goods, were criticized by the President. He does not concede that price rises were the inevitable effect of increased wages, shorter hours and the strange philosophy of the undistributed profits tax. Only the industries were singled out as the whipping boy. Steel and other prices, said the President, were disproportionate to wage increases.

Organized labor, particularly Lewis' CIO, was spurred to intensified efforts toward further organization, with additional wage boosts in mind, by the seven-to-four Supreme Court decision of April 12 which upheld the constitutionality of the Wagner Act. This momentous opinion held, in effect, that labor relations in the iron and steel, as well as in manufacturing industries generally, are definitely well within control of the Federal Government. It upset the traditional view that manufacturing and labor relations were not interstate commerce. Nevertheless, industry, which manifestly had shown deep interest in the case, accepted the decision in good faith and the opinion expedited elections under the direction of the CIO-inoculated National Labor Relations Board. On the other hand, the decision stimulated the bitter CIO-AFL fight for organization.

Seeks Aid of Business

Severe as was the headache Washington suffered from the labor situation it became of secondary consideration when the October stock market crash occurred. Though remaining outwardly calm the Administration readily realized its possibilities and soon after instituted conferences with business interests, seeking aid of private capital to check the "recession" and unemployment. The immediate objective looks to huge expenditures of private capital in low cost housing, estimated at $12,000,000,000 to $16,000,000,000 over a five-year period, and a large construction program by the public utilities which are behind $2,600,000,000 in construction outlay since 1932.

But the most immediately hopeful business stimulant lies in large railroad expenditures for equipment. Desperately pressed financially, the carriers, after being granted only $47,500,000 increased revenue by the Interstate Commerce Commission last October, now are asking for an annual revenue boost of $508,000,000 in its 15 per cent case.

The President is sympathetic to the plan. He said that the sooner the decision is made the better it will be for the country. It is believed that this Presidential attitude on behalf of the carriers was the cause for the ICC expediting the rail advance case by moving the start of final hearing to Jan. 17. It previously had been set for Feb. 7.

So while Washington still gropes in confusion and uncertainty, there are definite signs of a right swing by the Administration that has hopeful aspects for recovery—even if the swing may later take a reverse movement.

Lionel Green

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LABOR is industry's best customer. Employers are beginning to realize that good business means full employment at good wages.

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Labor

BY JAMES A. ROWAN
News Editor, The Iron Age

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The keynote of management for 1938 will be "labor relations." Employers and employees, this year, will find and follow their common interest, to rebuild prosperity.

STEEL manufacturers enter 1938 facing new problems in their relationship with the industry's half million employees.

Only four weeks remain before that group of steel companies which signed labor contracts with John L. Lewis' Steel Workers Organizing Committee must reopen negotiations (Feb. 7) on new union contracts.

Such companies, headed by United States Steel Corp., must decide whether they can, in view of the current business recession and industrial outlook uncertainty, again sign agreements freezing the steel wage for as long a period as 12 months at a minimum of $5 a day or any other fixed basis.

Likewise the group of steel concerns which have signed contracts to bargain collectively with their employees through the SWOC must be ready sooner or later to answer the SWOC's demands for the closed shop and the checkoff of union dues.

By far the most important issue is the wage outlook, and a survey of steel industry opinion shows that signed steel manufacturers are giving this phase close study.

With various units in the steel industry in general agreement that workmen are entitled to bargain collectively, the new year opens with steel producers still divided on the form collective bargaining should take. But if the steel industry is momentarily divided on whether or not to sign union contracts, the labor movement itself seems locked in a possibly fatal internal struggle in which Lewis and William Green, AFL president, are involved.

Problems the Union Faces

As 1937 drew to a close the steel union leaders, holding their first national convention (at Pittsburgh), found many things blocking Lewis' campaign for greater power in labor affairs and greater influence on the conduct of steel management itself. Among these problems are:

1—The Wagner Act, which gave labor its opportunity to organize on a large scale, faces a steadily growing demand for amendment or even repeal because of its obvious unfairness to business.

2—The new business depression has vastly weakened the SWOC's position in any demands it may make for a wage increase or for any other concessions and has made impossible the granting of the wage increases the SWOC would like to ask when its leaders next month begin negotiations for new contracts.

3—The independent steel companies which beat off the union's attempt to win union contracts in unsuccessful strikes called in the Chicago, Youngstown, Cleveland and other areas on last May 26 have renewed their warnings to industry of the labor monopoly dangers they see inherent in the checkoff and closed shop.

4—Growing pressure from the rank and file of union members that the SWOC "do something" to restore

business and jobs and provide relief for those members who had contributed dues since the organization of the SWOC in June, 1936.

5—Dissatisfaction among union members with the monopoly of highly paid union jobs by "coal miners" who are members of another Committee for Industrial Organization affiliate, the United Mine Workers of America. Few steel workers hold key positions in the steel union.

6—A trend in some steel centers such as Chicago and Weirton point toward stronger independent unions set up by workers opposed to the Lewis group's policy of use of violence, against Lewis' continued acceptance of aid from Communistic elements, and high dues ($1 a month plus assessments).

7—Failure of the SWOC to win its 1937 strike against four large independent companies has seriously hampered the work of unionization and has injured other CIO affiliates. The United Mine Workers Union, for example, lost its contracts with some steel company-owned coal mines when the steel strikes failed.

8—The difficulty of paying back large loans advanced for steel organization purposes by other unions in the face of declining dues collections is increasing.

9—Public opinion shows less inclination to support illegal picketing or other measures to make strikes effective and stronger opposition to sit-down strikes. This is reflected in the attitude of state, city and county authorities in industrial states toward law violators.

Union's Power Has Weakened

A visit to steel centers discloses many scattered signs that the SWOC will go into its February meetings with steel executives with its power to trade sharply reduced from a year ago. At Gary a recent union mass meeting, held in a central location and widely advertised as a step to restore jobs and strengthen the union, drew only 55 persons, including the union speakers.

SWOC relief stations in the Youngstown, Chicago and other areas have been closed due to lack of funds. Union lodges in some cases have been unable to pay rent for meeting places. Steel plants, forced in some instances by shrinking business during the closing months of 1937 to discharge large numbers of employees, found no opposition from union lodges.

On the credit side of its ledger the SWOC points to its record of observing meticulously the provisions of agreements signed last March by a number of steel companies. There is nothing in this record, SWOC leaders believe, that will permit steel concerns to refuse to sign new contracts on the ground that the steel union (regardless of the bad records of the United Automobile Workers and other CIO affiliates) has not kept its agreements.

Both the SWOC and executives of some steel companies which signed the controversial union contracts hold that such agreements ended labor difficulties in the signed plants for the life of the contract. Costs of dealing with the now illegal company unions were greater than costs of dealing with the SWOC, according to supporters of the union contract in the steel industry.

In any event, the principle of collective bargaining between employers and employees in the United States is now established.

Signed Contracts Still Opposed

However, the new year finds the group of steel executives who refused to deal with the Lewis union because of its irresponsibility more determined than ever in their unwillingness to sign CIO union contracts. Within the last few months heads of several such steel companies have bitterly criticized the SWOC and have warned employers generally against the closed shop and the checkoff.

Among steel manufacturers and in some other quarters is a spreading belief that the SWOC is now a shell, waiting to be cracked, more vulnerable than ever before, too weak to continue its organizing drives because of lack of funds and unable, because of the business recession and other factors, to support successful strikes against industries opposed to the checkoff, the closed shop, and other labor objectives.

Philip Murray, SWOC chairman, who holds the respect of many industrialists completely opposed to the SWOC's methods, apparently will go into the February contract meetings with steel executives compelled to bluff as never before regarding the number of steel workers he represents, his present power to force steel companies to grant the checkoff, the closed shop, or pay advances or, perhaps, to sign any sort of written agreements for 1938.

Labor leaders look hopefully to United States Steel Corp. for help in the making of new contracts and point out that, not three weeks after last year's strike in "Little Steel" began, Edward R. Stettinius, Jr., chairman-elect of the corporation, said in a public address:

"At present we are witnessing again the impact of new hopes and ambitions upon the habits and practices of the past, and are conscious of the tension

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LABOR, too, is beginning to appreciate the fact that its interests demand prosperous and busy plants.

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between established practice and a new concept.

"That new concept," said Mr. Stettinius, "is that our instruments of production, land, transportation, factory and office, shall, in the future, be conducted with more statesmanlike emphasis on the welfare of all involved—employees, stockholders, consumers and the public—that the goal of production shall not be profit alone, but material, social and spiritual betterment for all groups and all classes.

"With this viewpoint," he said, "enlightened business is thoroughly in accord. This is the spirit of our age, as the demand for political freedom was the spirit of '76. Fortunate indeed is the generation which correctly appraises the spirit of its time and makes the necessary adjustments with tolerance, fairness and mutual good will."

The SWOC Platform

Recently Mr. Murray, of the SWOC, described the SWOC's functions as follows:

"It is charged with the duty of promoting the interests of its members in order to gain for them a more equitable share of the profits of industry, and to seek for them a more secure and fruitful life.

"The SWOC is not a political instrument; it is concerned primarily with the organization of the nation's steel workers, no matter what their political leanings, for their economic betterment through collective bargaining with their employers. But through the very nature of its economic activity, the SWOC cannot ignore political action. Labor must place in office men who see human rights as transcending property rights. It must obtain progressive government. . . ."

Checkoff Demand Delayed

Mr. Murray emerged from the SWOC's national convention at Pittsburgh with full authority to get "the best contracts possible" from the steel manufacturers. A report of the SWOC, giving employers some insight into the February contract demands, indicates that no strong request for the check-off and closed shop will be made in 1938 but will be made in the future. The committee, headed by Clinton S. Golden, SWOC regional leader at Pittsburgh said on the check-off, closed shop and other subjects:

"When the present wage contracts were negotiated the SWOC was conscious of the immense volume of false propaganda disseminated by anti-union forces dealing with this question. In view of the long-established traditions of hostility to unionism in any effective form existing in the industry, it was considered both unwise and provocative to make such demands.

Looks to Future

"Your committee feels that a more cooperative attitude on the part of employers will evolve as confidence grows out of the collective bargaining relationships with the union and that the time will come when employers fully recognizing the responsibility and discipline of the union, will enable the union to function more efficiently in its sphere of operations."

Whether the steel industry is to have independent unions, the Lewis-SWOC union or no unions at all during the next few years is likely to be decided in February.

Wagner Act On Grill

INDUSTRY'S hopes for the early death and burial of the Wagner Labor Relations Act, the most controversial of recent New Deal legislation, increased as 1937 ended.

From all parts of the nation came bitter attacks on the act's un-Americanism, its wrecking of peaceful and friendly labor-employer relations and its heavy contribution to the Roosevelt depression.

Joining steel and other industrial leaders in their stand that the Wagner Act carries disaster for America, vast sections of the American public, thousands of workmen, many of whom are now without jobs, labor leaders, politicians, Government officials, publishers and others have appealed for repeal or drastic amendment of the act.

Still defending the Wagner law—which high officials of the Committee for Industrial Organization now openly boast they wrote in its entirety—are John L. Lewis, members of the National Labor Relations Board (the agency set up to administer the act), a throng of lesser labor leaders supporting Lewis' industrial unions, and many Congressmen still unwilling to believe that public opinion no longer supports the labor legislation so strongly advocated by President Roosevelt himself.

In the public's present attitude toward the Wagner Act and the Labor Board, now generally considered part of Mr. Lewis' CIO, a nationwide survey of labor conditions by THE IRON AGE disclosed interesting developments.

At Youngstown, center of Lewis' defeat in last summer's independent company steel strikes, steel leaders say the Steel Workers Organizing Committee apparently has become "afraid" of the public. It recently refused jury trials for more than a hundred of its members and supporters who were jailed for carrying guns into the Youngstown area last June to shoot down loyal workmen.

Instead, the SWOC advised its members to plead guilty to the charges.

Thus the SWOC attorneys, by refusing to allow juries to hear the cases against the union's gun carriers, came near to making labor litigation history. All the union's defendants brought to court as an aftermath of the threatened Mahoning Valley "massacre of 1937" pleaded guilty and were fined a total of $5,000. Two CIO organizations, the SWOC and the United Rubber Workers Union, paid all the fines.

Still unwilling, five months after the independent strikes, to face Youngstown public opinion as demonstrated through juries, the SWOC quickly cooperated with local authorities in getting the strike cases settled. One reason given by union leaders for the guilty pleas was that "trials would have cost the taxpayers money."

Rebellion Against Lewis

But also at other industrial cities where interest in the Lewis labor movement is naturally strong THE IRON AGE found growing evidence of a rebellion against Lewis, against his National Labor Relations Board and the Wagner Act, in which for the first time in American history, the Federal Government endorsed a particular labor union movement and set up machinery giving tremendous impetus to its organizing efforts and a semi-official character to all its acts.

Some employers, THE IRON AGE found, urge that the Wagner Act be killed. Others believe that it can be amended. Few offer hope or encouragement to the sweat shop employer that all collective bargaining legislation will be abandoned and nothing adopted to take its place. Most employers apparently favor some law establishing labor's right to collective bargaining and setting up rules for such bargaining on a fair basis.

Nearly all employers favor abolishment of the present National Labor Relations Board and condemn the strong arm methods it has used in gathering evidence. One corporation attorney said of the much-criticized Labor Board hearings:

"I have never seen witnesses so browbeaten, threatened and intimidated, nor a trial so unfairly conducted with the examiner who should have been an impartial judge taking the position of a prosecutor and utterly ignoring evidence in favor of the defendant."

Wagner Act Has Lost Friends

It is the Labor Board's method of conducting hearings on alleged Wagner Act violations that brought the greatest storm of criticism from steel plant operators and other employers, likewise from William Green and his American Federation of Labor and from many other sources.

Throughout the past year the Wagner Act has lost friends; opponents of the law at its beginning have steadily grown more critical and fearful of its results unless it is repealed or drastically amended. One manufacturer told THE IRON AGE:

"My views . . . have been somewhat colored by our disappointment both with the failure of the act and its one-sided unfortunate administration. It is my firm opinion that the act is an impracticable piece of legislation if part of its objective is to be fair and equitable to everyone and promote harmonious relationships between employer and employee."

Other manufacturers believed that experience under the Wagner Act has been no worse than they expected. One such manufacturer said:

"We tried to make leaders of organized labor see that a noose was being fitted around the neck of the liberties of American workmen, with the trap release in the hands of a Government bureaucracy. Today, workers have felt the heavy hand of oppression through the creature of that legislation, the National Labor Relations Board. They have seen simple American rights wiped out by the act of a Government bureau and judicial procedure challenged.

Suggestions for Amendment

In recent months a broadside of suggested changes in the Wagner Act came from employers in steel and other industries believing that the act had something in it worth saving. One industrialist offered this 20-point list of suggestions:

1—Have unions incorporate or otherwise accept legal and financial responsibility for carrying out their part of any agreement.

2—Prohibit all strikes called without consent of workers by a vote.

3—Limit pickets in any strike to employees of the particular plant concerned.

4—Prohibit the blocking of streets, as well as entrances to plants and offices by pickets.

5—Make it unlawful to organize mobs, to spread false propaganda, or call mass meetings for importuning of individuals for the purpose of making a mass demonstration with the intent of forcing factories to shut down or compel workers to give up their jobs.

6—That all sit-down strikes be declared unlawful.

7—That coercion or intimidation at any time, anywhere, by anyone, be unlawful.

8—Both employers and employees should have the right to request an election. Under the present law only employees have that right.

9—Permit management to express its views on labor unions just as freely as unions or individuals can do so under the present law. "The present Wagner Act throttles free speech as far as management is concerned."

10—Have the law provide that one labor election does not impose upon a plant a union for all time.

11—Breach of contract on the part of the union should automatically suspend its right of representation.

12—Prohibit unions from making assessments for political purposes. (The British Trades Disputes Act enables union members to forbid the unions to use their dues for political purposes.)

13—Insist that officers and agents of a union be American citizens.

14—Recognize by law the principle

Partiality of Labor Board Is Even Recognized "At Home"

Some National Labor Relations Board officials—like hundreds of employers — have little faith in the fairness of the Wagner Act.

Recently the regional director for the Labor Board in one of the most important areas in the country, a district in which the board's biggest cases have originated, said:

"Sometimes business men come into my office to see me about complaints their employees have made and say 'we want to place all our cards on the table. We want to do the right thing by our men and we know we will get a square deal in your office.'

"I don't want them to get the wrong idea about the situation. Right at the beginning I tell them 'you are wrong. You won't get a square deal here and I don't want you going out of here thinking you will get a square deal.'"

To employers who complain about the unfair method in which the board's examiners conduct hearings on alleged Wagner law violations, attaches at the office of the Regional Director mentioned above merely pointed to Section 26, Labor Board Rules and Regulations which says:

"In any such proceeding the rules of evidence prevailing in courts of law or equity shall not be controlling."

THE "spell binder" is losing his appeal in the light of practical performance.

of the right to strike and also the right to work without molestation.

15—Outlaw all sympathy strikes.

16—Make it unlawful for employers to store arms or ammunition to be used for strike purposes. Make it unlawful for pickets to have firearms, clubs, or any other weapon which may be used to cause injury.

17—Establish a National Labor Board and regional labor boards which will be unbiased in their arbitration of labor disputes.

18—Consider a violation of an agreement on the part of the union or employer as an interference with the free flow of interstate commerce.

19—Make it unlawful to picket a plant or state that a strike exists in any plant in which 50 per cent or more of the normal number of employees are at work.

20—Force labor organizations to submit reports periodically to the Government covering their financial operations, including membership dues, salaries, contributions to political campaign funds and all other expenditures.

Act Promotes Industrial Strife

Warning that the Wagner law is undemocratic and certain to promote more industrial strife unless it is repealed or amended, another manufacturer said:

"The entire act in my opinion is largely directed to hamper and harass craft organizations (as favored by William Green and the AFL) in favor of an industrial type of organization (backed by Lewis) designed to pit all employees, skilled and unskilled, common labor joined with trained specialists, against the employer. Therefore, my thought is that the whole act is bad legislation from the standpoint of promoting the American theory of progress and opportunity.

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"However," he said, "if no relief is possible from the entire act and if the country must work under some such law and regulation, either temporarily or permanently, I feel that . . . fundamental modifications in the law are basically essential if equitable application is to be achieved."

A separate Federal court of industrial relations was suggested by a manufacturer opposed to the "kangaroo court" procedure under which the various Labor Board hearings are now conducted. He suggested further that:

(a) The act should "require that at least 15 days before a strike is called a written statement of the demands of the union on the matters of controversy be filed with the Department of Labor in order that the issues may be clearly understood by all of the parties, and further, that a Governmental agency be provided an opportunity to prevent what is the equivalent of war in the industrial field."

(b) The employer should, by express provision of the act, be permitted to request an election so as to determine the proper organization or representatives for collective bargaining. The board has construed the present act to prohibit applications for elections by an employer and as a result employers are compelled to make a determination of the proper organization at their peril. The condition necessarily makes for discord and increases the number of controversies before the board.

(c) Functions of the Labor Board should "be exclusively administrative, being confined to the receipt and investigation of charges, their adjustment by conferences if possible, and the filing and prosecution of complaints. The determination of the cases under the act should be judicial and not administrative so as to assure fair and unbiased hearings.

(d) Labor Board hearings should be expedited. "It is not uncommon for a hearing before the board to last several months, and even minor cases involving but a handful of employees often take a week or two."

All employers interviewed were bitter against the sit-down strike and complained that through the Wagner Act the Labor Board functions in an atmosphere of prejudice against employers so strong as to hamper efforts to maintain industrial peace. One employer said:

"The prejudice against the employer ought to be removed and a real judicial inquiry substituted. For example, the practice is to give to the prosecuting attorney for the board unlimited quantities of subpoenas and deny or sharply limit the subpoenas made available for the employer. In addition, the practice of the trial examiners has been, by their own questions and their attitude generally, to assist and encourage the prosecution rather than conduct the hearing in an impartial fashion."

Thinks Checkoff May Be Illegal

An attorney for one of the larger steel manufacturers pointed out that among the Wagner Act's confusing provisions is one which can probably be used to show that the checkoff of union dues (one of Mr. Lewis' objectives for all his unions) is illegal.

(Section 8 of the Wagner Act reads, in part, "It shall be an unfair labor practice for an employer . . . to dominate or interfere with the formation or administration of any labor organization or contribute financial or other support to it.")

By taking over the responsibility of collecting union dues through the checkoff, any employer certainly would be giving the union the "other support" which the act expressly forbids, the steel company attorney said. Thus the checkoff violates the Wagner law by encouraging membership in the union with which the checkoff agreement is made and hampering the free development of any new labor organization, according to this attorney's interpretation.

Outlines Act's Weaknesses

Pleading for protection for "substantial minorities" of workers under the Wagner legislation, a leading Midwestern manufacturer offered the following list of the act's weaknesses:

1—The Labor Board informally establishes the principle that an employer, after a claim has been filed with the board, is guilty until proved innocent.

2—I cannot reconcile myself to the idea of the National Government providing an attorney for a union to press charges against an employer. Unions are supposed to be self-supporting. Therefore, why shouldn't they be responsible for the fees of their counsel?

3—The manner in which the board functions makes it necessary for an employer to keep accurate records of everything unpleasant about an employee during his stay with the company. The reason for this is so that discharges that may occur in the future can be substantiated. The psychology created by attempting to keep accumulated records of every man's misdeeds does not help to build a harmonious relationship between management and the working force.

4—The National Labor Relations Act carefully defines unfair labor practices for employers. It contains nothing as to what constitutes unfair labor practices by a union. Also, how would they be enforced?

5—The act requires an employer to observe the results of the Labor Board election. However, the board has been futile in causing unions to desist in their troublesome organizing efforts after the union has lost an election. In other words, the election proves nothing unless the union wins.

6—Members of the board apparently have adopted the basic credo that all workers want to belong to unions. Such is not the case. The majority do not want to belong to unions, and members of the board should acquaint themselves more thoroughly with the actual thinking and wishes of the working people.

7—Members of the board seem totally oblivious to the fact that unions every day violate the law through the use of violence and intimidation. We should have some board members who are capable of dealing with the realities of unionism rather than the idealism of how they expect unionism to function maybe a generation hence.

Views of Other Industrialists

A West Coast manufacturer said he saw American industry facing an emergency in the Wagner Act and declared:

"There is no piece of work that can be done in behalf of industry that will have more constructive value than presentation to members of Congress of the real facts and actual practical working of the National Labor Relations Act."

The president of a company in the New York area told THE IRON AGE that "the present act and the machinery to set it up cannot be called democratic in our opinion. On the contrary it is confiscatory and if you want to call that Communism or Socialism, go to it."

However, an Ohio employer said he believed that the "trial examiner at the original hearing (involving his company) was very much prejudiced in favor of the employees, but the board seemed to give us a fair hearing."

Among manufacturers questioned as to their experience with the Labor Board under the Labor Relations Act was one executive who said he feared that expression of his opinion on the act might be prejudicial to his case before the board.

Charges of "failure to bargain in good faith" were made by the Labor Board against a Midwest machinery company because, according to its president, the concern failed to sign the particular type of contract that had been offered it by the union. "We have never refused to sign a contract but we have refused to sign the particular type of contract presented," he said. The board likewise, he added, claimed the company sponsored a company union. "There is no basis for any of these charges," the executive said, "for we never have had a company union nor has the company nor any of its officers or directors ever encouraged or sponsored, directly or indirectly, a company union.

"We feel," the machinery company official said, "that these charges were filed for the purpose of coercing and intimidating us into signing a union contract. During our negotiations regarding four men, which the board claimed we had discharged for union activities, the regional (Labor Board) director said, 'it is not so much these men, but are you going to give the boys the kind of a contract they are entitled to?' Surely this shows that the Labor Board, which is a Governmental agency, is not impartial, but to the contrary, was using its office to attempt to force us to signing a CIO contract."

o o o **BACK to work at the Chevrolet forge plant after a shutdown.**

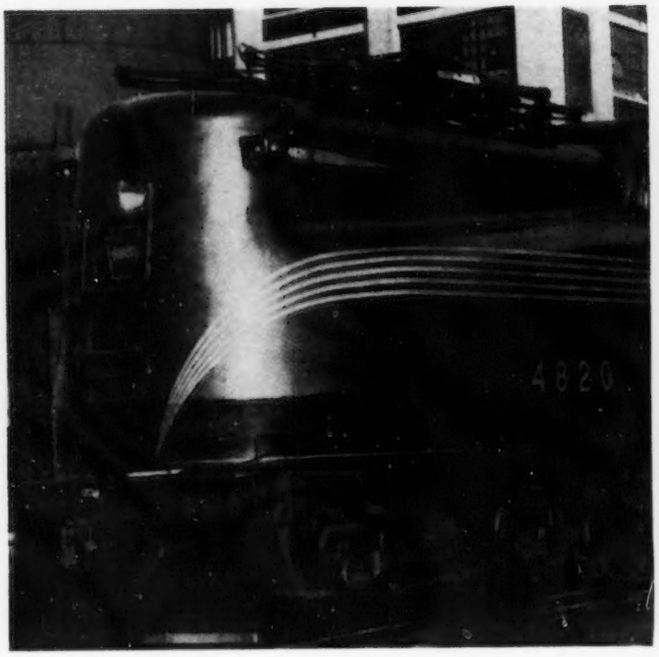
AMERICAN railroads started out valiantly enough in the first quarter of 1937 to maintain the pace set in the latter part of 1936 in the way of equipment purchases. By mid-year, however, it was evident that this spurt in buying was over and by the last quarter an undeclared buyers strike was literally in effect as the roads fought for an increase in freight rates in the face of declining loadings and revenues. Only in rail inquiries and orders was there a spurt near year-end. What the immediate future has in store for steel sales outlets largely hinges upon the action of the Interstate Commerce Commission as regards the request for an increase in freight and passenger tariffs.

Domestic locomotive orders totaled 291 in 1937 up until the middle of December, as compared with 533 in 1936. Of these, 172 were steam powered, 102 diesel-electric and 17 electric. The diesel-electric powered units reached a record number. Only three of these were 3600-hp. double units and the remainder were switchers of 300 to 900 hp. and preponderately of 600 hp. No new diesel streamlined trains were ordered and no self-propelled diesel cars, but six 1200-hp. diesel-electric streamlined trains, ordered in late 1936, were placed in service, also one 5400-hp. unit.

Two gasoline-mechanical streamlined cars of the American Car & Foundry Co. equipped with a horizontal six-cylinder engine were delivered to the Chicago & Eastern Illinois in April, and one "Rebel" streamlined three-car train to the Gulf, Mobile & Northern in November. These were the only rail cars built in 1937 for domestic service. Alloy steel and aluminum have been used in the construction of the car bodies and the trucks are cast steel.

With 49,726 freight cars ordered for domestic service up to mid-December, the sharp revival in freight car buying that began in 1936 was not matched by 17,818 units or 26 per cent of the 1936 volume of 67,544 cars. Extraordinary activity was displayed in the early months, but buying fell off sharply later in the year. By the end of June, 91.3 per cent of the total number of cars for the year had been ordered. For Canadian service 7388 cars were ordered. Only 1150 were exported.

Orders for domestic passenger cars followed a similar course. Although the 1937 total of 486 cars was 59 per cent above the 306 cars ordered the previous year, practically all the orders, 93.8 per cent, were concentrated in the first six months. The largest single order was for 50 more of the New Haven's modern coaches. Canadian railroads ordered 91 cars. For comparison, the British roads ordered 2000 passenger cars during the first nine months.



America is looking to our railroads. Looking to them with the hope that a beneficent Government rate policy will enable them to become a real factor in renewed purchasing.

Economic Phases of Railroads

Burdened with mounting taxes, together with higher labor and material costs, which are only fractionally covered by the $47,500,000 boost in basic commodity rates granted them last October, the railroads again have knocked at doors of the I.C.C. urgently pleading for a much more substantial advance in carrying charges. Faced, they say, with a great emergency, the carriers insist that favorable and quick action is necessary on their new petition which proposes an aggregate annual increase estimated at $508,000,000. It proposes a flat increase of 15 per cent in freight rates, with few exceptions, which it is calculated would raise $495,000,000, and increases from 2c. to 2½c. in coach rates on Eastern railroads, following advances in coach fares on Western and Southern roads. On bituminous coal and coke rates the railroads are asking an increase of 15 per cent, except where the October decision provided an increase of 15c. per ton, the maximum advance asked is 10c. per ton.

Unless liberal relief is given, predictions are made of widespread railroad bankruptcy with visions of Government control or even ownership. And, if denied more revenue, the railroads, a billion-dollar-a-year customer, buying 70,000 different articles, say they will be unable to come into the market and respond to the recovery drive by purchasing, as they should, the broad range of supplies they ordinarily consume, such as 17 per cent of the steel, 23 per cent of the bituminous coal, 19 per cent of the oil produced, and 20 per cent of the cut of timber. The headway they have made in developing an efficient, economical and safe transportation, it is urged, cannot be maintained without more funds. To the tune of $900,000,000 a year for several years the railroads will come into the market for equipment to modernize their plant, restore employment

Alfred Cook

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A NEW era in rail transportation is reflected in new design conceptions.

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BY FRANK J. OLIVER

Associate Editor, The Iron Age

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Railroads

and project a strong stimulant for recovery, provided the rate increases asked are granted. So President Ralph Budd of the Chicago, Burlington & Quincy Railroad told the commission.

With operating expenses kited by $664,789,000 a year greater than in 1933, owing to new taxes, higher wages, and advances in the level of material costs, the railroads find that the margin between income and outgo has been squeezed so thin as to imperil their future operation. Their present net earnings of approximately 2.5 per cent on investment available for interest, dividends, improvements and reserves definitely bars them from substantial increases in purchases without increase in revenue. Operating revenues in 1937 are estimated at $4,164,000,000 as compared with $4,053,000,000 in 1936, an increase of only 2.7 per cent, and with $6,280,000,000 in 1929, a drop of 33.7 per cent.

*Much of the technical data presented in these and following paragraphs was abstracted from a survey made by Committee RR6 of the Railroad Division of the American Society of Mechanical Engineers and presented in the form of a report to the annual meeting of the society in December.

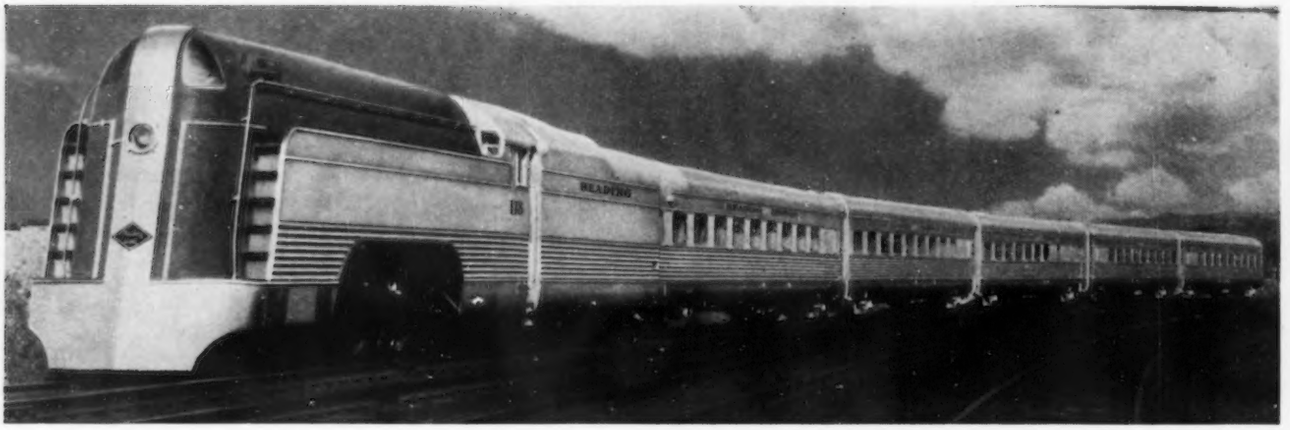
Adequate revenues manifestly, it is contended, must be something more than barely enough to meet necessary expenses of maintaining and operating the railroads. They point out that if they are to survive, they must also take in enough to pay a reasonable return to the 2,000,000 who have invested directly in railroad securities, and the tens of millions who have invested indirectly through their ownership of insurance policies and savings bank deposits. Obviously, too, they are of extreme importance to railroad employees, whose number dropped some 58,000 from the 1937 peak of 1,174,332 in July to 1,115,919 in October.

Economic studies indicate that if the railroads are to continue modernization of their plant and reduce their indebtedness, the railroads must realize from 10 to 20 per cent more than expenses. According to the Association of American Railroads, in the 12-year period 1921-1932, including the period of great general prosperity, the net income of railroads, available for interest on debts, dividends to stockholders and improvements to their properties, averaged less than 4 per cent on the investment.

Tendency Toward Higher Average Speeds*

There was small chance, under those conditions, to retire indebtedness or to accumulate reserves for the depression years which were to come, even had the stockholders during good years foregone entirely any dividends upon their stock. Railroads, so they maintain, had no boom and went into the depression without surplus reserves. Yet they have been faced with rising taxes, wages and material costs and threatened legislation, such as the proposed 70-car train bill, which would add $100,000,000 a year to their operating expenses. Rate increases are held to be utterly inadequate to meet the financial load heaped upon them, the carriers say, and, unless it is lightened in the way of quick and substantial increased rates, they will be stalled.

The high speed trend in both passenger and freight services by the



READING'S light-weight stainless steel streamliner was the first to be placed in operation in the Middle Atlantic States. The Pacific type steam locomotive was remodeled in the Reading shops, while Budd furnished the five "shotwelded" stainless steel cars. The train runs between New York and Philadelphia.

railroads is noted all over the world, without spectacular top speed records. Efforts are manifest everywhere that the trend set by especially developed vehicles must be and will be followed by more conventional equipment.

Fastest freight service is exemplified in Illinois Central's train MS-1 running between Chicago and Memphis, Tenn., 527 miles, in less than 13 hr. Average speed between some points is over 50 m.p.h.

In March, the Southern Pacific put into service the new *Daylight* streamlined trains between San Francisco and Los Angeles, covering 471 miles of curved line at a commercial speed of 48.4 m.p.h., while other trains average only 39.2 m.p.h. Normal equipment consists of 12 stainless steel cars and a 4-8-4 type steam locomotive. In May, the Santa Fe replaced the former standard cars on its *Super Chief* with nine stainless steel cars, and on a demonstration run averaged 60.5 m.p.h. on the 2228-mile run between Chicago and Los Angeles. The regular running time of 39¾ hr. at 56.1 m.p.h. has not been changed, however, on the timetable. *The Chief*, the Santa Fe's daily steam train on the same route, has again been speeded up slightly to 50 hr. 44 min. westbound or 44.0 m.p.h. An average speed of 44.6 m.p.h. is attained on the eastbound run of the Union Pacific's *Forty-Niner* between Chicago and San Francisco.

The Union Pacific's diesel train, *The City of San Francisco*, has been so successful that a new train of 14 revenue cars, instead of the present nine, is under construction. *The City of Denver* had 12 min. cut from its eastbound run, where it now averages 67.1 m.p.h. over the 1048 miles between Denver and Chicago.

In the eastern territory, a further speeding up of the New York Central's *20th Century Limited*, which now averages 58.2 m.p.h. between New York and Chicago, and of the Pennsylvania's *Broadway Limited*, which averages 55.0 m.p.h. over the shorter route with the same running time of 16½ hr., is contemplated in 1938, when the new equipment for these trains will be ready.

The fastest electric train, the Pennsylvania's *Congressional Limited*, be-

Railroad Equipment Orders in 1937

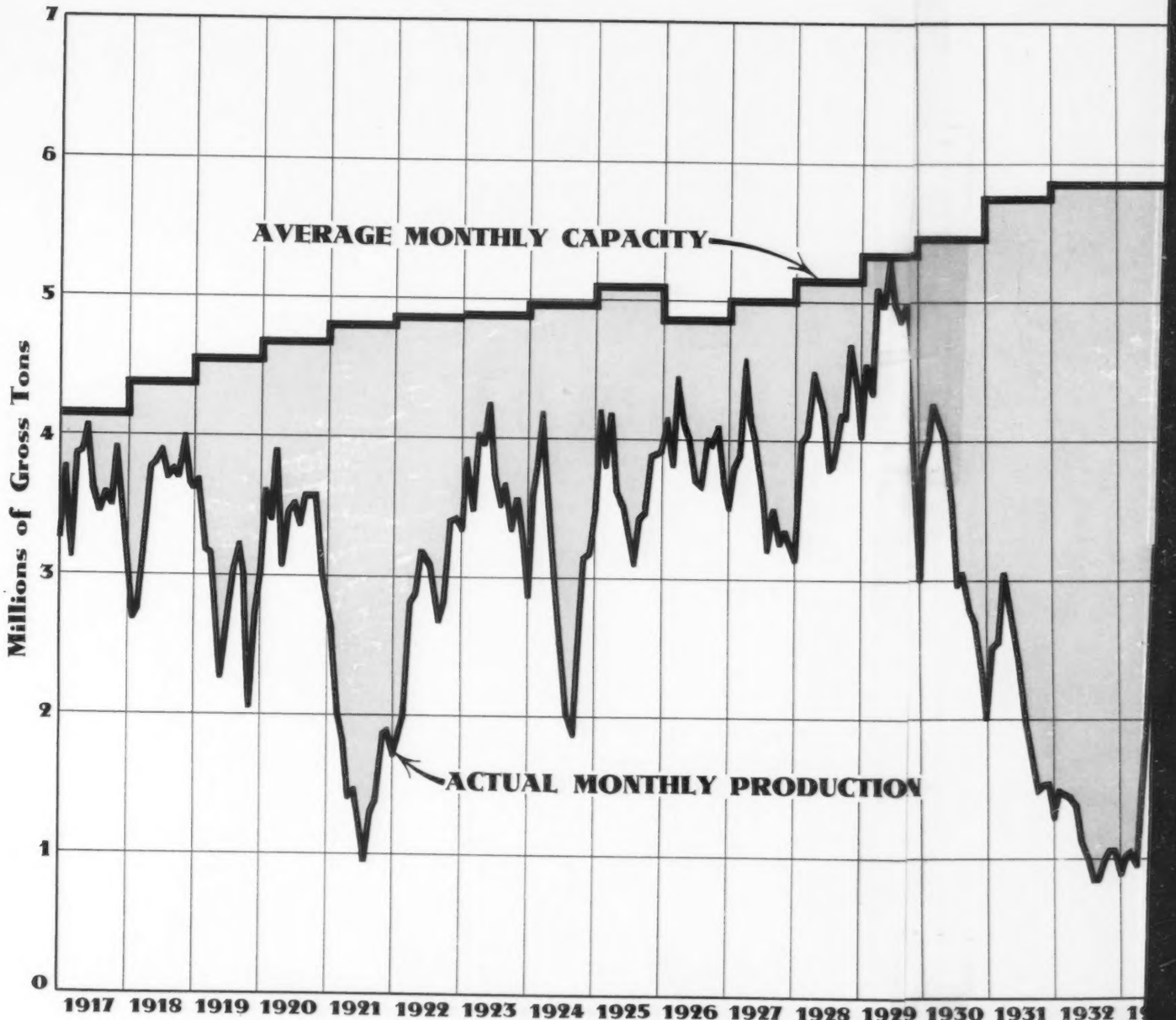
Statistics compiled by Railway Age on railroad equipment ordered in 1937* are as follows:

Equipment Ordered	
Freight cars for domestic service	49,451
Freight cars for use in Canada	7,388
Freight cars for export	1,550
Total	58,389
Locomotives for domestic service	291
Locomotives for use in Canada	51
Locomotives for export	45
Total	387
Passenger cars for domestic service	486
Passenger cars for use in Canada	91
Passenger cars for export	0
Total	577
Locomotives, domestic—Steam	172
Diesel-electric	102
Electric	17
Total	291

Orders for Freight Cars Since 1921

Year	Domestic	Canadian	Export	Total
1921	23,346	30	4,982	28,358
1922	180,154	746	1,072	181,972
1923	94,471	8,685	396	105,552
1924	143,728	1,867	4,017	149,612
1925	92,816	642	2,138	95,596
1926	67,029	1,495	1,971	70,495
1927	72,006	2,133	646	74,785
1928	51,200	8,901	2,530	62,631
1929	111,218	9,899	3,023	124,140
1930	46,360	1,936	1,200	49,496
1931	10,880	3,807	151	14,838
1932	1,968	501	77	2,546
1933	1,685	75	132	1,892
1934	24,611	12	1,323	25,946
1935	18,699	2,421	110	21,230
1936	67,544	271	526	68,341
1937	49,726	7,388	1,550	58,664

* All 1937 totals to Dec. 18 only.



Ingot produc
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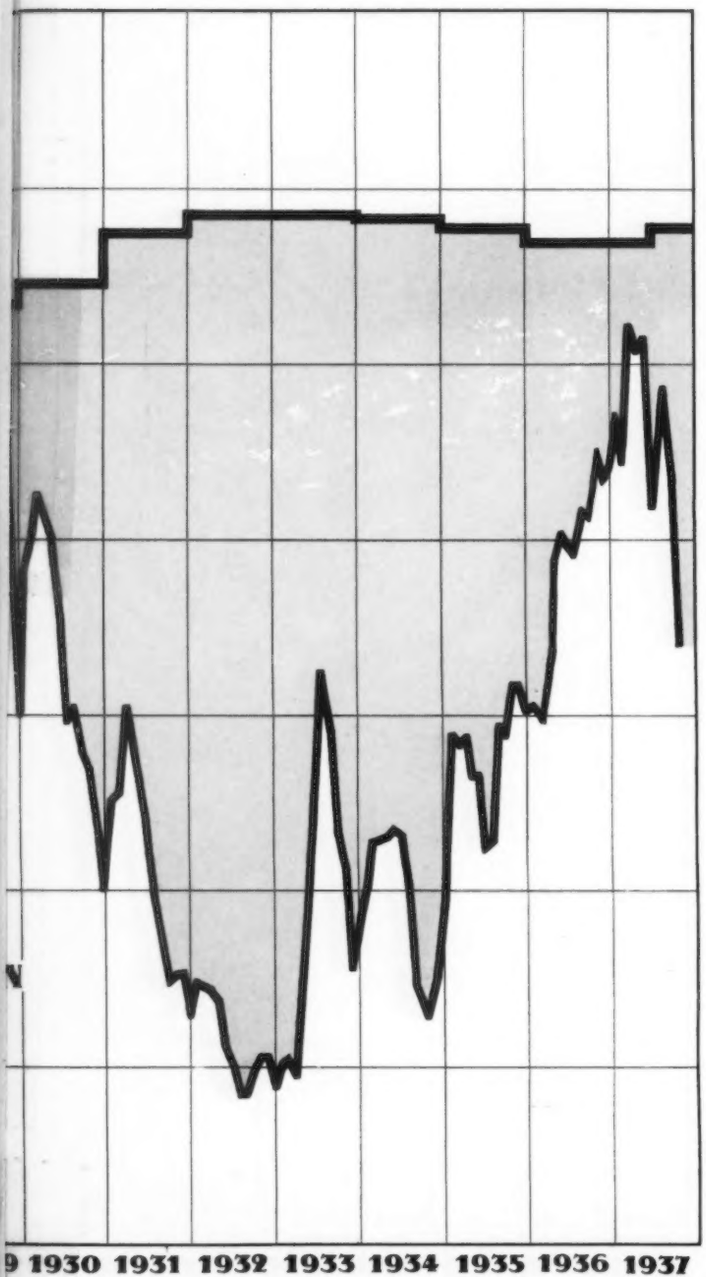


Ingot producing capacity was increased during 1937 by 194,500 tons to a total of 68,485 362 tons of open-hearth and bessemer steel.

UNIV. OF MICH.

tween New York and Washington, had its schedule cut by 5 min. to 215 min. for 226 miles, averaging 63.1 m.p.h. with six stops.

The Pennsylvania in January announced the extension of its electrification to Harrisburg, Pa. Scheduled to be completed in 1938, this and several associated freight line electrifications involve 315 miles of line and 773 miles of track, rounding out the program of 1928, which had been delayed by the depression. The Pennsylvania will then have 2677 miles of electrified trackage or 37 per cent of the total in the United States. No other electrifications are scheduled in this country. The 17 high-power electric locomotives ordered last year were all for the Pennsylvania.

Annual Increases Since May, 1933, in Operating Expenses of Class I Railroads:*

Unemployment compensation law	$58,453,000
Railroad Retirement Act tax	52,584,000
	$111,037,000
Materials and supplies other than fuel	$197,154,000
Fuel	78,170,000
	$275,324,000
Restoration in 1935 of 10% wage deduction agreed to in 1932	$174,961,000
Wage agreement under the Railroad Labor Act by National Mediation Board, 1937:	
Non-transportation employees	$95,697,000
Train and engine forces	38,221,000
	$133,918,000
Total increases per year	$695,240,000
Less saving due to transfer of voluntary railroad pensions under Railroad Retirement Act	30,451,000
Total net increase per year	$664,789,000

* Source: Association of American Railroads.

Steam Locomotives

A third lot of 50 of the successful Hudson-type engines of the New York Central is currently being received from the American Locomotive Co. Principal differences from the earlier orders include light-weight reciprocating and revolving parts. Boiler pressure has been raised 50 lb. to 275 lb. per sq. in., and the boilers are larger and heavier, though made of nickel steel. Aluminum cabs and running boards on 30 of the engines will save some of this added weight. All engine axles are equipped with Timken roller bearings and five locomotives will receive Timken roller bearing rods. The last 10 locomotives are to be streamlined to pull the new *20th Century*. All have rubber draft gears.

SKF and Timken bearings are applied to all the axles of the 10 Baldwin-built streamliners of the Hudson type for the New Haven. They have 80-in. drivers. The most powerful Hudson-type locomotives under construction are probably the nine ordered from the American Locomotive Co. by the Chicago & Northwestern. They have a tractive effort of 55,000 lb. as compared with 43,500 lb. for the Central's and carry 300 lb. boiler pressure. The Burlington equipped a standard Hudson-type locomotive with a streamlined stainless steel cover and roller bearing rods, which is intended for relief duty on the *Denver Zephyr* and other high-speed runs up to 100 m.p.h.

Noteworthy among the powerful 4-8-4 type locomotives built in 1937 are five delivered by Baldwin to the Richmond, Fredericksburg & Potomac; 14 streamlined by Lima for the Southern Pacific, and 20 built by the American Locomotive Co. for the Union Pacific. The Lima units are the largest streamlined locomotives, although of somewhat lesser drawbar pull.

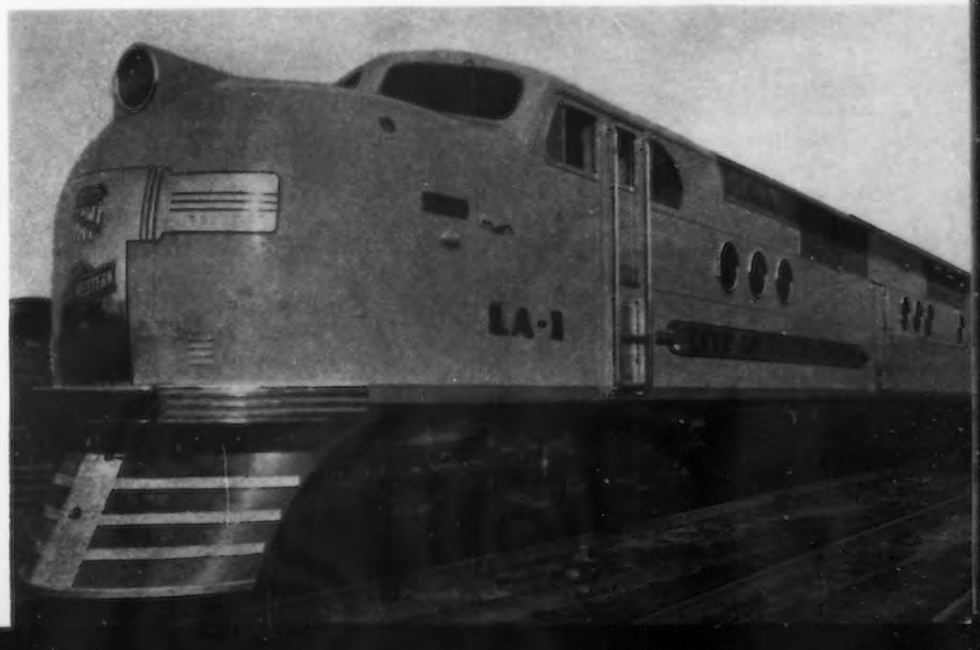
High-speed Mallet designs of 1936 have been very successful and substantial orders were filled, the Union Pacific taking 25 of the 4-6-6-4 type and the Northern Pacific 15. The Southern Pacific had 14 additional units built of its 4-8-8-2 type, with cab in front.

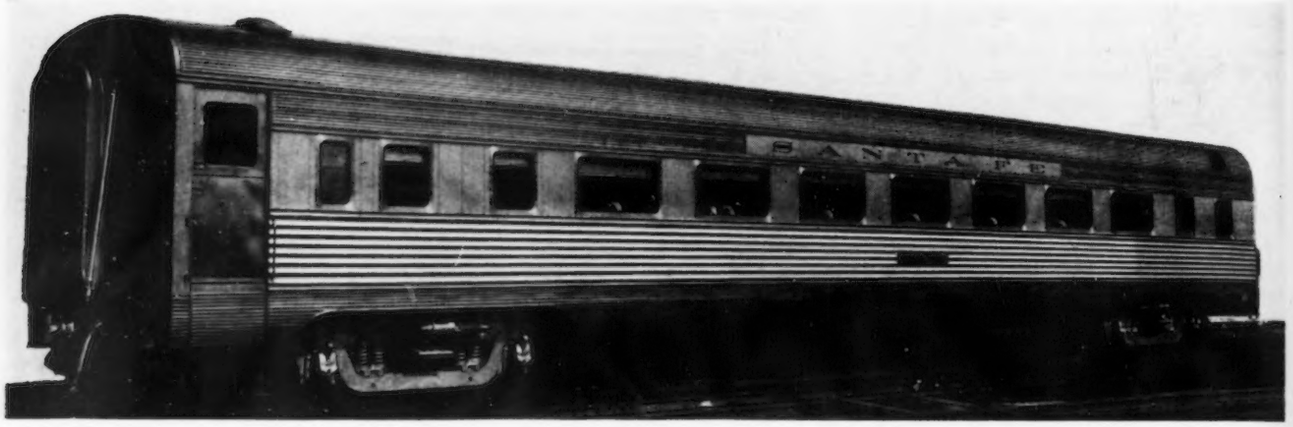
In December, the Reading put into operation the first light-weight, stainless steel streamlined train to be seen in the Middle Atlantic States. The steam locomotive is a Pacific type encased in a streamlined shell constructed of stainless and painted steel. The lines of the locomotive correspond with the sheathing of the cars. Each of the car bodies is fabricated of 18-8 stainless steel by the Budd "Shotweld" process. Shatterproof glass is used throughout.

A novel type high-powered passenger locomotive was completed by the Baltimore & Ohio in June. Of 4-4-4-4 type, one pair of cylinders each has been placed front and back of the driving wheels and connected to two different axles. All four cylinders are cast integral in a one-piece cast steel Commonwealth frame of 60-ft. length. Boiler pressure is 350 lb. The Union Pacific's 5000-hp. turbo-electric locomotive is still under construction.

New high-speed developments by the Pennsylvania and the B. & O. are under way. Both will be streamlined. The latter will receive individual axle drive by four Besler four-cylinder high-speed steam motors operating on 350-lb. steam pressure. This engine will develop 5000 hp. and will be

THE *City of Los Angeles* is drawn by the world's largest diesel-electric locomotive, built by Electro-Motive Corp. and rated at 5400 hp. It began drawing 17-car train between Los Angeles and Chicago on Dec. 27 and is jointly operated by the Union Pacific and the North Western.





A NEW light-weight stainless steel chair car, in service on the Santa Fe's *Scout*.

capable of pulling 14 Pullman cars along a level track at 100 m.p.h.

Diesel-Electric Locomotives

Electro-Motive Corp. delivered its second 3600-hp. double-unit locomotive to the Santa Fe for hauling the *Super Chief* in May, and two identical units to the B. & O. in June for service on the *Royal Blue* and the *Capitol Limited*. Two more were ordered that month. A fleet of six 1200-hp. *Rocket* trains built for the Rock Island had likewise standard Electro-Motive power cars. After development work extending over several years, the Baldwin Locomotive Works, late in 1936, completed a 600-hp. diesel-electric switcher, which subsequently was purchased by the Santa Fe. Power is supplied by the recently developed De La Verne six-cylinder, four-cycle engine. The American Locomotive Co. applied the Swiss Büchi system of supercharging on 900-hp. transfer locomotives of the Birmingham Southern, using standard 600-hp. diesels, the performance of which has been raised by the supercharger. Two Cummins 12-cylinder, four-cycle diesel engines operating at the high speed of 1000 r.p.m. have been applied to a 90-ton mixed service locomotive recently delivered to the Fort Worth & Denver City.

On Dec. 27, the Union Pacific and the Northwestern started the *City of Los Angeles* on its 39¾-hr. run between its name city and Chicago, same running time as Santa Fe's *Super Chief*. It has 17 cars, making it the world's longest train, just lacking 5 ft. of being ¼ mile long, and it is drawn by a 5400-hp. diesel-electric locomotive, also the world's most powerful, made up of three units each containing two 900-hp., two-cycle diesels.

This locomotive and the cars, many of them Pullman "Roomette" cars with folding single beds, were ordered late in 1936.

Domestic Railroad Equipment Orders by Quarters in 1937

	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Year's Total
Locomotives	108	120	50	13	291
Freight cars	27,613	17,477	2,715	1,921	49,726
Passenger cars	386	70	15	15	486

Passenger Car Trends

A stiffer car-body structure has been employed in the nine new stainless steel cars for the *Super Chief*, which weigh 1190 lb. per ft., as compared with 1050 lb. per linear ft. for the original experimental stainless steel cars built by the Edward G. Budd Mfg. Co. for the Santa Fe. Body weight, exclusive of trucks, is 820 lb. per ft. Return has been made to the modified Pratt truss construction for the side frames in place of rectangular framing used in the original car. A stainless steel sleeping car, named *Forward*, of substantially the same construction was built by the Pullman Co. at the end of 1936. Like the Budd type cars, truss framing carries the entire load, with loosely applied sheeting. It weighs 870 lb. per ft. for the body alone. This compares with a weight of only 770 lb. per ft. for the body of the Milwaukee's *Hiawatha* cars, which have Cor-Ten sheeting, skin stressed with the tubular framing. New cars for the Union Pacific's *Challenger* have aluminum bodies,

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PULLMAN CO.'s new "Roomette" cars provide passengers with a folding bed and complete toilet facilities, a one-passenger compartment at 1.5 times the regular fare.

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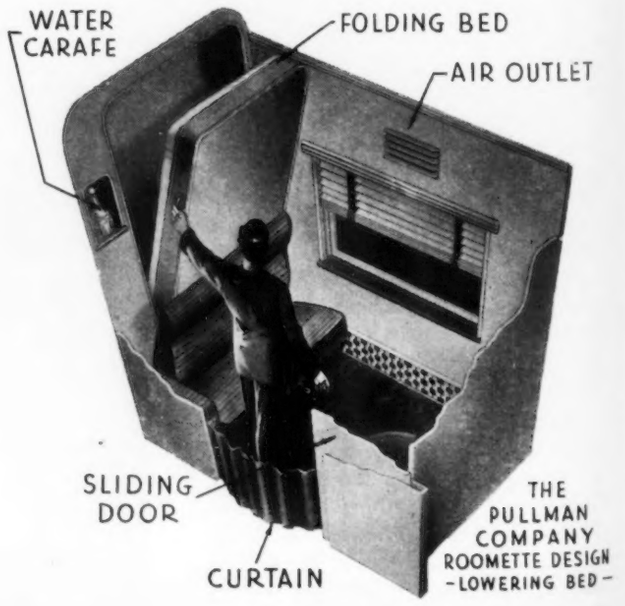

with a weight of 870 lb. per ft. for the body alone.

Stainless steel sheathed equipment with Cor-Ten frames received much favor, as indicated by the two 12-car trains for the Southern Pacific's *Daylight* service and two eight-car trains for the same road's *Sunbeam* between Houston and Dallas, Tex. The corresponding weights per linear foot are 1300 and 1350 lb. *Rocket* trains for the Rock Island have been built according to the Budd process.

A preliminary report presented last June by a committee of the Association of American Railroads on tests with the 50-ton light-weight alloy steel boxcars indicated that car No. 9000, built of Cor-Ten steel of reduced sections and standard riveted construction, warranted favorable consideration, with minor modifications of body bolster and center plate. Car No. 500, built of the same material, but welded throughout, was found to require extensive changes and reinforcements as well as improvements in welding technique. Meanwhile, Pullman Standard Car Mfg. Co. built car No. 501, a redesigned all-welded 50-ton boxcar of 10 per cent greater volume. This car weighs 9.5 lb. per cu. ft., as compared with 9.9 lb. for car No. 500, built by Pullman-Standard in 1935. Car No. 9000 was built by Mt. Vernon. Considerable development work is being done in welding by the Milwaukee and the Delaware & Hudson, and general indications are that boxcars of this size can be satisfactorily built of low alloy steel with a dead-weight-to-payload ratio of less than 36 per cent. On car No. 501, this ratio is 35.3 per cent.

Hopper cars of Cor-Ten or equivalent steel are in demand. The original extremely light designs have been somewhat strengthened in later orders.

In the latter part of the year, the Utah Copper Co. purchased 250 high-strength alloy steel cars of the gondola type of 100 tons capacity for transporting ore. These cars were built by the Pressed Steel Car Co. and conform in general dimensions and capacity to other similar cars made of plain carbon steel. A saving of 9000 lb. or 16 per cent in dead weight through the use of "Cumoloy," a copper-molybdenum steel of 78,000 lb. per sq. in. ultimate strength, makes it possible to use 16 per cent more cars per train on the return grade empty, which is the determining factor in these operations. This steel is not only stronger, but corrosion proof.

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ONE of 500 automobile box cars completely assembled by spot welding of high-tensile low alloy steel in the shops of the Milwaukee Road.

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IN its own shops, the Lehigh Valley is building 20 cabooses sheathed with 3/32 in. low-carbon steel plates, with wood lining and double wood floors.

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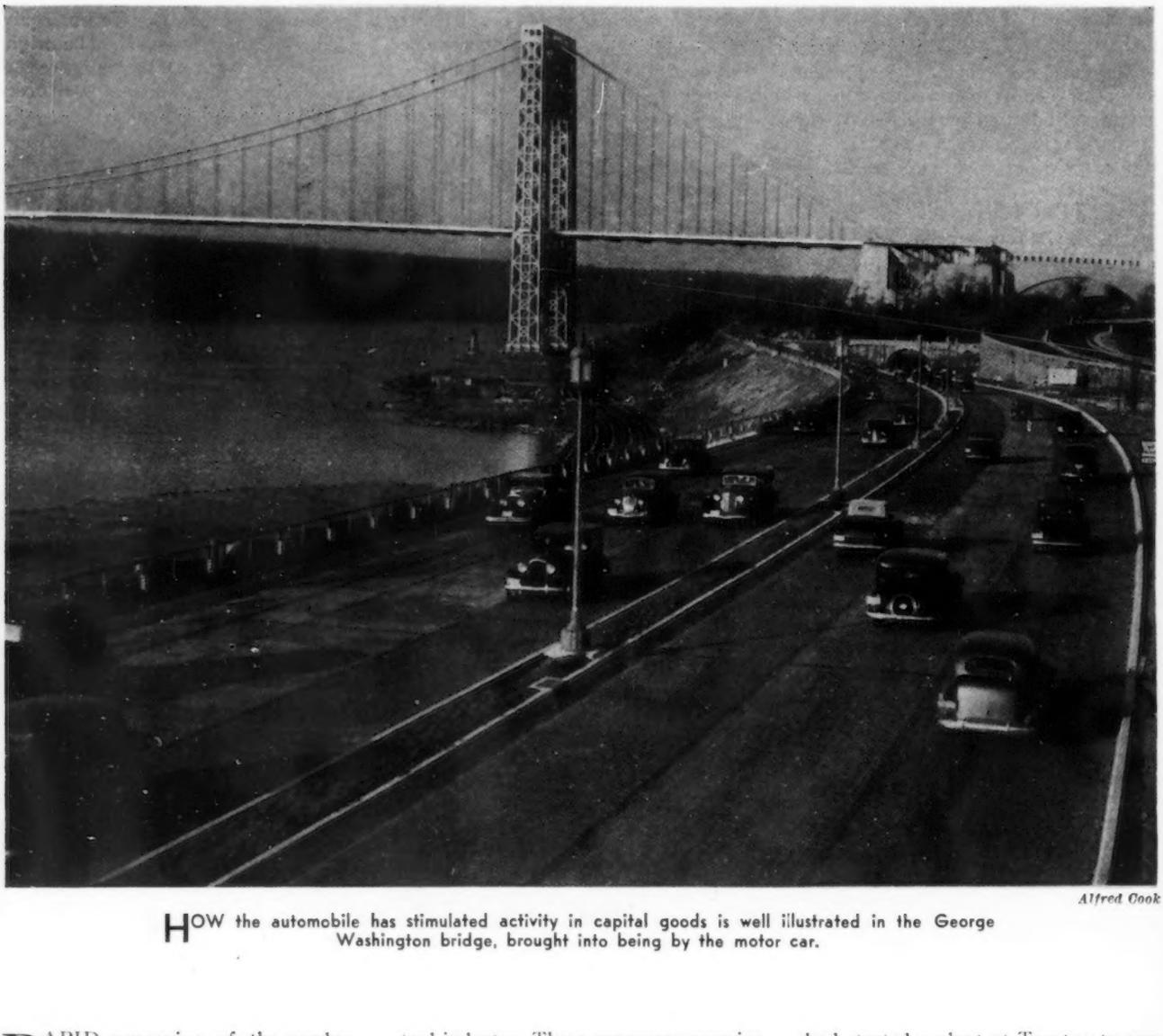

Alfred Cook

HOW the automobile has stimulated activity in capital goods is well illustrated in the George Washington bridge, brought into being by the motor car.

RAPID expansion of the production capacity of the automobile industry, even in the face of unsettling influences, sets the past 12 months apart from any previous period of automotive history. The program has not been clearly one of decentralization, any more than it has been one of concentration of plants, but instead it is a readjustment in each direction. Economic and labor conditions have suggested this program to provide greater potential output, while operating on a shorter work-week, with greater security from interruptions of operations. It has made the industry more widespread in its activities, at the same time bringing both manufacturing and assembly plants closer to the sources and markets they must have. In no small measure, the building and tooling programs carried out in the last year have been a boon to steel fabricators, building constructors and necessary adjuncts, and to the machine tool industry. These programs promise to continue during the new year.

Each of the big automobile producers and a score of supply plants participated in the expansion, spending $100,000,000 in the vicinity of Detroit alone. Even this represents only a part of the total industrial growth generated by the auto industry.

Principally on account of General Motors Corp. expansions, New Jersey has become an outstanding automotive area, with six important General Motors divisions now located there and Bendix Aviation and numerous automotive supplying firms following suit. The corporation added to its principal holdings in this Eastern state by erecting the Linden assembly plant Costing more than $5,000,000, it will turn out Buicks, Oldsmobiles and Pontiacs at a 120,000 yearly clip. Before the year had passed, the Inland Mfg. Division was preparing a plant near Cranford, N. J., and Ternstedt had started a plant at Trenton to supply body hardware to GM's units on the east coast. Buffalo, growing in importance in the General Motors' scheme of things, has just seen the completion of a new motor and axle plant for Chevrolet. Capable of producing 1200 motors and 1200 axles each day, this unit is Chevrolet's first effort at manufacturing such subassemblies at any other than its "home" plants. It is apparent that in its two-year-old program involving some $60,000,000, General Motors has not confined itself to a mere decentralization of assembly operations but has set up numerous new primary manufacturing centers.

Not originally scheduled in Buick's $10,000,000 appropriation for 1937, a plant for the manufacture of the new self-shifting transmission was erected during the year at a cost of an additional $5,000,000. This automatic type transmission was introduced during

Automotive . . .

W. F. SHERMAN
Detroit Editor, The Iron Age

o o o

The motor car industry led America out of the so-called "Hoover depression". Is it going also to lead us out of the present "Roosevelt Depression"?

the last model year on Oldsmobile and is being manufactured by Buick for both the Buick and Olds cars. Prospects for the next year are that the industry will equip many more plants of this type because of the success that attended this transmission's introduction to the driving public.

GM Builds Diesel Plant

Great importance attaches to General Motors' single large project at Detroit, a $1,500,000 diesel plant now ready to go into production on a complete line of oil-burning units ranging upward from 20 hp. and designed for truck, marine and stationary applications. This makes the corporation's coverage complete, including diesel locomotives and similar large units. Other large additions put up by GM units include a full square block of additional production space at Inland's Dayton plant and a $4,000,000 program sponsored by Frigidaire.

While the full extent of Chrysler expansion has not been learned, a $4,000,000 development northeast of Detroit for the manufacture of Dodge trucks was the nucleus of a now rapidly developing industrial colony which will effect considerable change on the map of southeastern Michigan. Almost immediately the Briggs Mfg. Co. started a $3,000,000 plant nearby to manufacture auto accessories and moldings. Numerous other corporations, including the Divco Twin Truck Corp. and the Carboloy division of General Electric, made preparations to settle in the locality. Chrysler also followed the trend to decentralization in establishing a transmission plant at Kokomo, Ind., spending $500,000 to recondition the former Haynes Automobile Co. factory. DeSoto added 100,000 sq. ft. of floor space to its one-year-old building and added new banks of large presses to its sheet metal division.

Ford Starts $40,000,000 Program

Ford was a most important factor in the year's expansion programs. More than $1,000,000 worth of tire manufacturing machinery was bought last spring for a tire and rubber manufacturing plant at the Rouge. The company has under way at present a $40,000,000 program mainly in its iron and steel divisions. A 1000-ton all-welded blast furnace will be built, a second new battery of 61 by-products coke ovens is under construction supplementing two present batteries, two

ONE of the largest assembly plants in the world, General Motors new plant at Linden, N. J., was put in operation early in 1937. At full capacity the plant will employ approximately 2000 persons and will have a capacity of 120,000 cars a year.

MORE than half the cars and trucks delivered from factories are being carried on carriers like these streamlined all-metal tank type trailers.

large gas storage holders were started during the year, the open-hearth furnaces are being rebuilt and enlarged and a new cast alloy steel foundry building will be started. New equipment will be in operation before long in both the hot and cold strip rolling mills to provide additional production capacity. A third 110,000 kw. turbo-generator is being supplied by General Electric.

Not covered in the announcement of the $40,000,000 program is a new press shop and body assembly building and a huge consolidated tool and die shop. Late in the year Ford Motor Co. of Canada, Ltd., put into operation a $3,300,000 plant to manufacture and assemble bodies at Windsor. This

AT RIGHT

GREATEST style change of the year, introduced by Graham in its distinctive 1938 models, presaging some of next year's lines.

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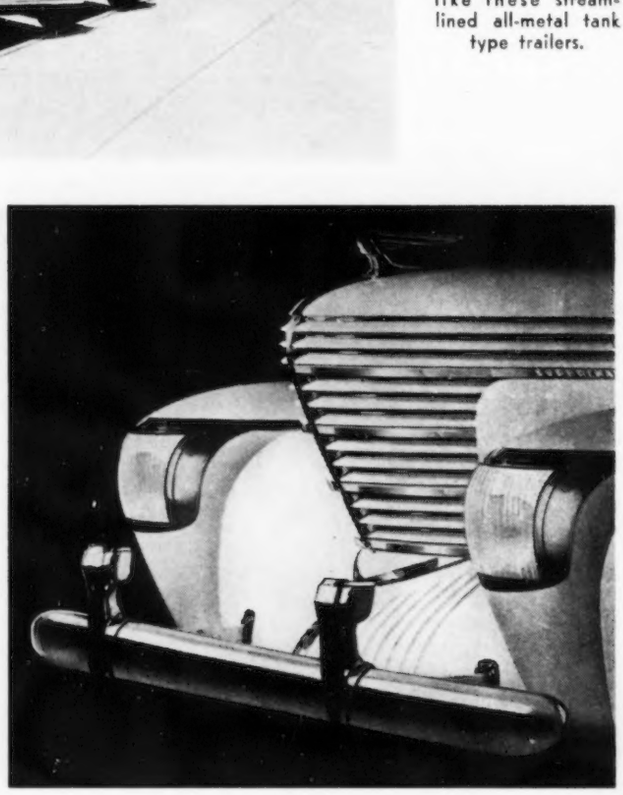
BELOW

THIS year's auto shows will bring out many cars without running boards like this 1938 Cadillac Special Sixty.



was part of an ambitious program intended to increase Ford's Canadian capacity by at least 25 per cent. An additional $1,700,000 was spent for the enlargement of the main manufacturing plant at Windsor and to modernize production facilities.

An important newcomer among the automotive suppliers is the Firestone Steel Products Co., whose $1,000,000 plant at Riverview, Mich., will supply metal products.

A general 20 to 30 per cent increase in theoretical output was sought by car makers through the addition of these plants and purchase of new machinery to "thread the line" and eliminate bottlenecks. This raises the estimated capacity of the industry from its previous level of 5,700,000 cars and trucks per 10-month year, but actually the present output is difficult to estimate accurately because the industry is in a state of flux, with labor acting deliberately to regulate production, and management already well set in the operation of the industry on a two-shift basis rather than three.

Labor Troubles Trying

The year has done little to bring about a final settlement of differences between management and labor in the automobile industry, but without doubt the experience gained in more than 12 months of strikes and contract negotiations will be used to advantage in reaching a real solution. Most significant of all the events of the last year are the contractual relationships that have been set up between the United Automobile Workers International Union and the General Motors and Chrysler corporations. These two important branches of the industry, heretofore on an open-shop basis, suddenly found themselves highly organized through the medium of the sit-down strike. Almost all of the supplying plants in the industry have been similarly organized by the UAW. Battle lines are now being drawn by the UAW and its one untested oppo-

nent, the Ford Motor Co. More likely than not, this test will come soon, probably in the form of "economic force" directly against Ford and indirectly on Ford suppliers. In the case of General Motors and Chrysler, contracts have been found to be not binding enough to prevent a steady series of wildcat strikes uncontrolled by the union and, as the new year opens, settlement of this problem seems to be vital.

Significant trends within the labor movement which will affect the automotive industries include the phenomenon of the factory workers' strike in the Kelvinator plant at Detroit to obtain recognition of the Mechanics Educational Society of America as bargaining agent for office employees. While the sentiment of office workers in the automobile companies is, in general, not sympathetic to union organization, the Kelvinator incident indicates possibilities which have not been given much consideration.

Except for a long-drawn session of sit-down strikes and other labor disturbances, the industry's goal of record production might have been realized. As it turned out, assembly lines never did quite catch up with sales and demand during the 1937 model year. However, the recession felt so severely near the end of the year made necessary a revision in estimates of 1937 production, so expert observers now believe that the final figure will be a few thousands under the 5,000,000 mark. This is, however, a growth of nearly 10 per cent over 1936, consistent with the gain made from 1935 to 1936.

Reduced Output Expected

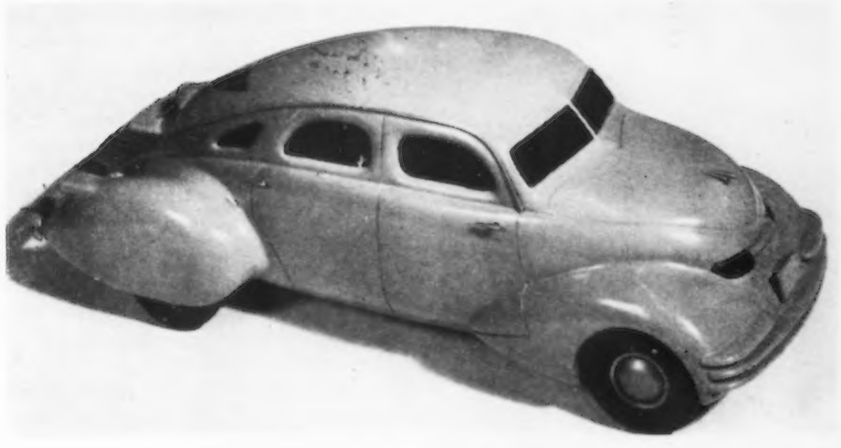
THE industry has conceded since early fall that higher prices and the apparent business recession mean decreased sales in prospect for the coming year. Estimates vary widely on probable production, ranging from 2,500,000 on the pessimistic side to 4,500,000 plus, with such an expert as John Scoville, Chrysler Corp. statistician, on the optimistic side. The final figure will be as high as recovery is rapid, the market-wise agree. Early spring buying is expected if business as a whole hits a recovery stride. Besides this, the industry feels the need of an exceptional good-will reception of 1939 models when they are introduced next fall. To this end designers are now awaiting approval of initial drawings and proposals which, if approval is gained, will mean radical changes in the new cars. Trends already are plotted by the popular appeal of certain features on 1938 cars.

The automatic transmission built by Buick for its own cars and Oldsmobile has been an important factor in Buick's gaining an amazing acceptance among car buyers during the fall and winter. Various gear-shifting mechanisms to simplify driving and clear the front compartment floor board have had similar wide appeal. The styling that Willys pioneered was so well received that it put this company back on its feet and somewhat similar lines promise to do the same for Graham. A somewhat different styling offered by Lincoln Zephyr and Ford in its deluxe models is certain to have counterparts on the road next year. Attempts at air conditioning will be more general. In minor detail, such as battery location under the hood and in the use of high-output voltage regulated generators, the trend is almost complete now. In engines, the most distinct trend appears to be that involving the use of hydraulically regulated tappets in the valve mechanism, a maintenance feature likely to be carried even further.

Chassis Changes

The outstanding step in chassis construction for 1938 models involved Buick's and Packard's attempts to provide proper rear wheel suspension. In neither case was independent suspension of the driving wheels attempted, Buick using coil springs and its former type of torque tube and conventional axle drive while Packard continued the use of leaf springs with new shock absorber arrangement and special mechanism intended to end the unpleasant rear seat ride. A structural as much as a style note was struck by Cadillac in its elimination of conventional running boards. It is freely predicted that all General Motors cars and probably those of competitors will eliminate running boards in next year's designs.

Already the machine tool industry and die makers are considering schedules that will enable them to assist the automobile plants in setting up for such extensive changes on next year's models. Most of the programs are expected to start this month.



AUTOMOBILES of the future are presaged in these two unique models.

Alfred Cook

Aviation

The flight to metal makes gains. in 1937.

WELL-BALANCED progress in the direction of greater commercial acceptance, more assured safety, lower costs, increased production and improved design has been recorded in 1937 by the aircraft industry. Still wearing glamor like that of the Lindbergh era, commercial aviation has gone ahead with exploration of overseas routes and the steady development of air transportation at home. But in no small measure, the gains that aviation can justly boast are those that have given it more definitely an important place among other important metalworking industries. Matured now in its business outlook, this industry is in a favored position to stride ahead to greater commercial prominence and influence.

Industrially, the outstanding achievements of the past year concern themselves with the final stages of the development and general adoption of zinc-lead dies and the utilization of drop hammers and hydraulic presses. Culminating several years of experiment and small-production work in stamping metal parts for airplanes, the art has reached an impressive stage. In high-speed hydraulic presses, gains have been so notable that Douglas Aircraft Co., Santa Monica, Cal., now claims that it has the largest equipment of this kind in the world. It is a 5000-ton unit capable of turning out an average of 6000 finished dural parts in eight hours.

Design Turns to Metal

Twelve months ago the prospects for mass production of the smaller planes—those suited to the needs of the so-called private pilot—were being studied. Design and tooling for the production of all-metal planes in this category have made rapid strides since then, thereby curing an unbalance in the industry, so that there are in existence today plants which can do quick assembly of such airplanes from parts which they can stamp quickly on precision dies. To gain these advantages, design has turned more and more to metal structure, even in wings which a year ago on this type plane were largely made of wood and fabric. As an example, wing spars for the Luscombe airplane are extruded by the Aluminum Co. of America. Incidentally, there is marked growth in this practice of having an experienced outside company fabricate parts for which it is especially tooled.

Ryan Aeronautical Corp., San Diego, has one of the most modern sheet metal divisions in the industry and has in practice production methods which unquestionably could be used to turn out hundreds of airplanes at a great saving over former methods. Accuracy of fabrication has kept pace with speed, so the assembly problem now is greatly reduced from past practice. With all parts of the new Ryan cabin plane stamped from precision zinc-lead dies, the component parts fit together so well that there are but 10 principal points which must be determined by jigging—three wing fittings at each wing-root and the four engine mount fittings. The Luscombe shop, at West Trenton, N. J., claims similar ease of assembly.

Spot Welding Comes Into Use

The first major use of spot-welding on aluminum alloy structural parts for aircraft came in the last year. At the Seattle factory operated by the Boeing Aircraft Co., much riveting is eliminated in the wing covering for the new Boeing Pan-American 72-passenger Clippers, which have a loaded weight of 85,000 lb. The wing skin for these huge airliners is Alclad, aluminum alloy. It is electrically spot-welded in strips for the 152 ft. wing, then anodized. When these planes are put in service during 1938 they will inaugurate a 24-hr. trans-Atlantic run. Further progress in welding is indicated for this year, since much effort is being expended in this direction. Adaptation of stainless steel, spot-welded as in modern railroad practice, has been predicted.

Metallurgical gains made during 1937 should be reflected in greater load bearing capacities and greater strength of aircraft built this year. Partly through better manufacturing control of steel tubing, it is reported, and partly through improvement in the yield strength of the metals, the allowable loads for aircraft steel tubing are being stepped up, in some cases as much as 28 per cent.

Large Sums for Airways

Projection of available data on production and sales of aircraft and parts indicates that the industry during 1937 registered an increase of about 70 per cent over 1936. Sales of aircraft, engines and spare parts totaled $80,615,059 for the first nine months of the year, compared with the first three-quarters of 1936, when the total was $47,978,661, according to the Aeronautical Chamber of Commerce of America. These data were broken down as indicated in above table.

RECAPITULATION OF ALL PRODUCTION AND DELIVERIES

Jan. 1-Sept. 30, 1937

	Production			Deliveries		
	Units		Per Cent	Units		Per Cent
Commercial Airplanes	1,917	$15,127,321	18.8	1,854	$15,105,485	18.8
Military Airplanes	539	23,417,246	29.0	541	23,498,482	29.1
Commercial Engines	3,352	11,338,213	14.0	3,292	11,337,193	14.0
Military Engines	1,490	11,014,857	13.9	1,495	11,080,120	13.8
Airplane Spares		13,368,942	16.6		13,368,942	16.6
Engine Spares		6,224,837	7.7		6,224,837	7.7
		$80,491,416	100.0		$80,615,059	100.0

In the provision of necessary landing places and navigation aids, there has been a substantial expenditure of funds during 1937 and an even greater amount of spending is already under way for 1938, with large sums allotted also for the period ending in 1940. The establishment of the Federal airways system as it exists today has required the expenditure of $12,000,000. Congress, in the appropriation act for the fiscal year 1938 has made available $7,000,000. Although only $3,000,000 of this may be expended before June 30 of this year, the Department of Commerce is preparing to let contracts for the total expenditure, the remaining $4,000,000 to be expended before June 30, 1940.

Since 1935 the lion's share of the department's expenditures has been directed into the radio and communication fields. In 1937 the radio group got 55.9 per cent and teletype service took 7.6 per cent of the total. In large part (73.6 per cent) the money allotted for 1938 will be spent for radio and teletype equipment such as the 400 new radio range towers for which contract proposals have been issued. The 17.1 per cent used for field and lighting purposes goes largely for electrical apparatus. These towers, incidentally, will require the purchase of about 12,000 tons of structural steel. Since the type of radio equipment required is not available in fabricated stock, contracts will be let by the department for the construction of hundreds of pieces of such apparatus.

An integrated program for the provision of adequate large airports was launched in December with the department, the airlines, aircraft manu-

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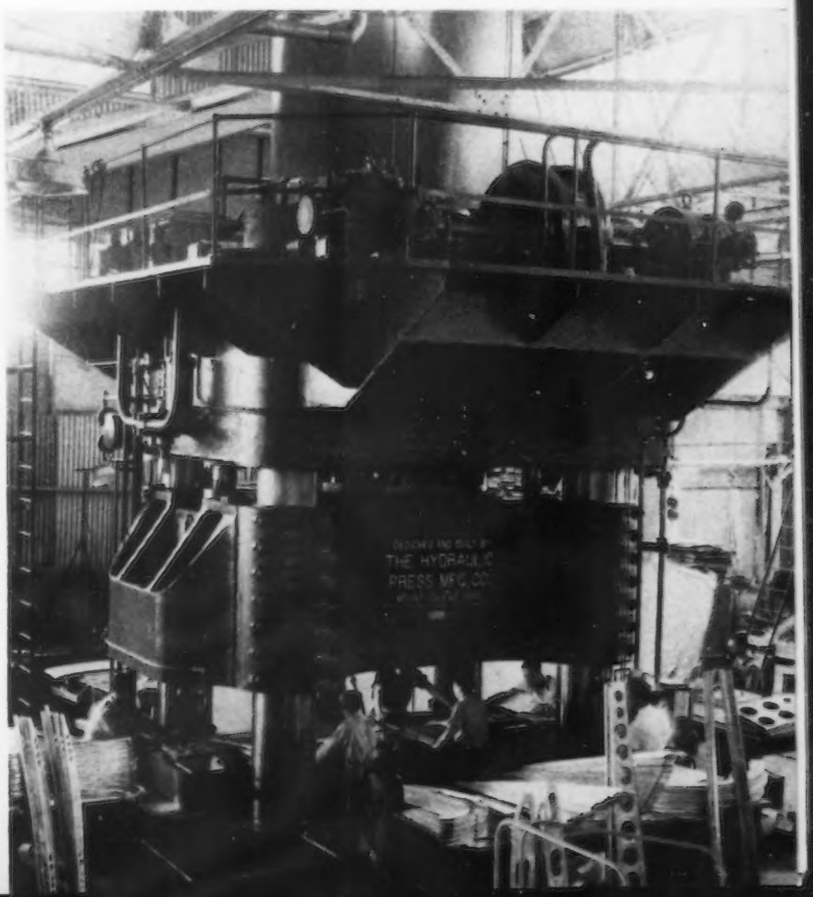

APPLICATION of metal to aircraft brings a demand for metal working equipment. At right, huge hydraulic press in Douglas Aircraft Co. plant.

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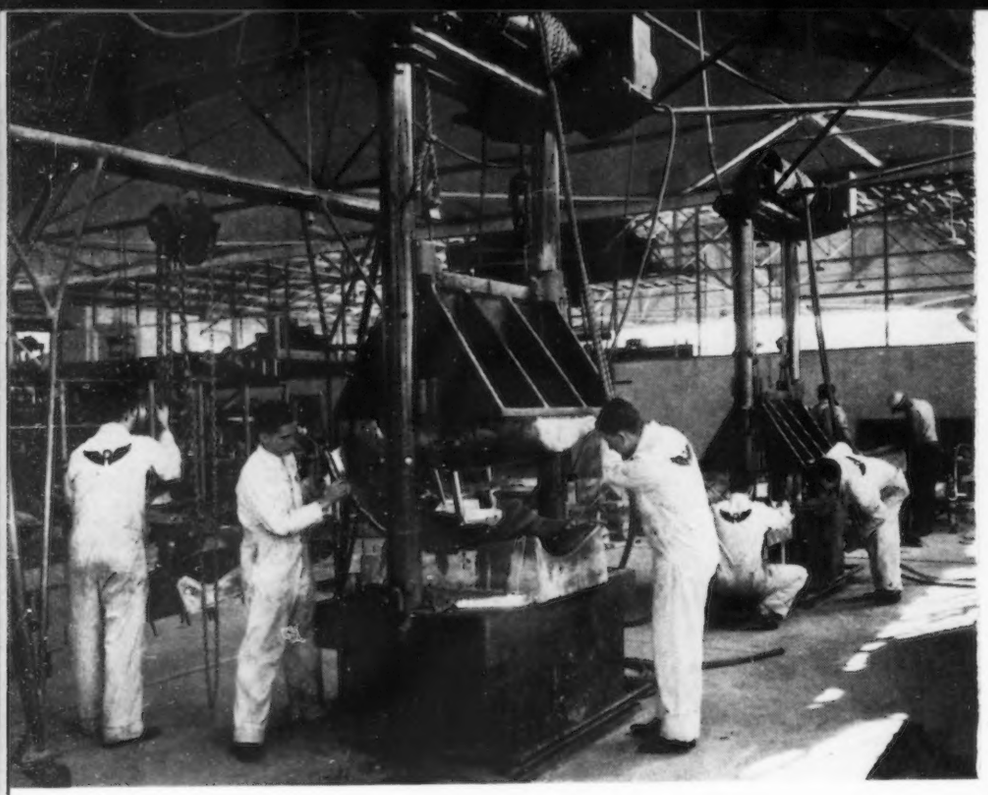

Corps. From Wright Field, Dayton, Ohio, came the test approval last spring for the new Allison V-1710, a 1000-hp. engine weighing only 1275 lb. and especially suited for high-speed, high altitude flying. It is a 12-cylinder, V-type engine, cooled with ethylene glycol rather than water. Since the coolant has a boiling point of 387 deg. F., the effectiveness of heat transfer from engine to atmosphere is increased, permitting use of smaller radiators. Frontal area is only 6¼ sq. ft., compared with about 16¾ sq. ft. for air-cooled radial engines (of less power) now generally used. It is especially adapted to an Army-developed turbo supercharger which will maintain the full 1000-hp. output up to 25,000 ft. for rapid climb and high-speed long distance flights.

Advances in foundry technique have made possible deeper and more closely

facturers, municipalities and the Post Office Department participating.

Utilization of the airways and aids thus provided has more than kept pace with expenditures. The cost has decreased in relationship to use from 7.2c. per passenger-mile flown by airlines in 1931 to 1.1c. per passenger-mile in 1937. At the end of 1937 passenger-carrying American air transports, domestic and foreign, were operating 77,000,000 airplane-miles a year, on a daily average schedule of 212,582 airplane-miles. In addition there was a gain of more than 1600 pilots from Oct. 1, 1936, to the same date in 1937, the total now being 17,379 pilots of various ratings, including 7493 transport pilots. Licensed airplanes increased from 7747 to 8430.

U. S. Regains Power Title

The distinction of producing the world's most powerful light-weight aircraft power plant has been returned to the United States through joint efforts of a division of the General Motors Corp. and the U. S. Army Air

ABOVE

BY the Ryan precision drop-hammer process, large sheets of 24 ST Alclad aluminum alloy are pressed into the proper shapes for fitting onto Ryan S-T and S-C metal planes.

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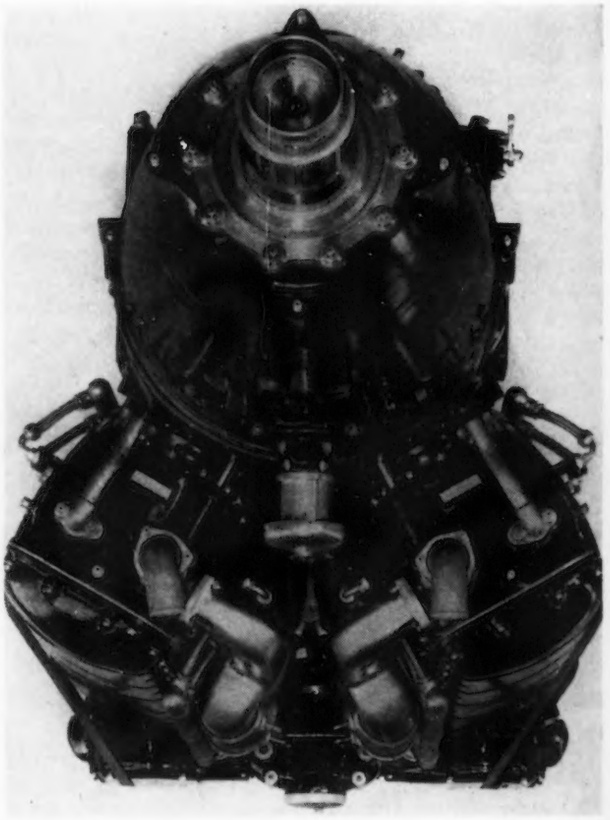
BELOW

IN the sheet metal shop of the Boeing Aircraft Co., Seattle, Wash., workmen seaming together sheets of Alclad aluminum alloy with an electric spot welding machine for the outer wing skin of section of the giant 152-ft. wings for Pan American Airways' new 72-passenger Boeing trans-oceanic Clippers.



ABOVE

THE Allison V-12 is the first engine to pass Air Corps 150-hr. type test for engine of normal rating above 1000 hp. An outstanding 1937 achievement.

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A REEL of Alclad aluminum alloy sheet shaped for the outer skin of a section of the new Boeing Pan-American Clipper's wing. The metal, seamed together by electrical spot welding, is being anodized in the finishing shop of the Boeing Aircraft Co. at Seattle.

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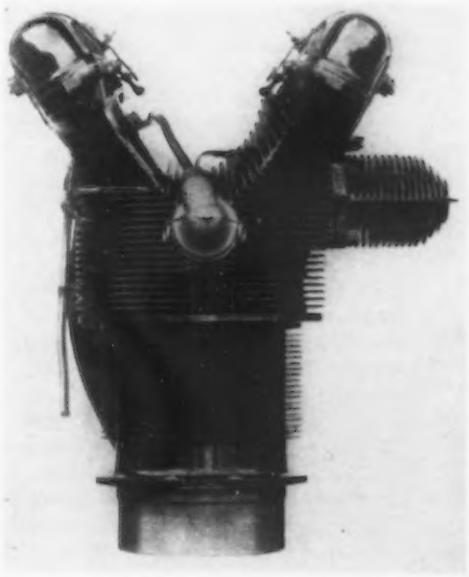
spaced cooling fins on air-cooled radial engines. For instance, the new Lycoming engine, built by the Aviation Mfg. Corp., has more than double the cooling surface available on previous models, giving 20 sq. in. of cylinder fin area per cu. in. displacement of the engine. In the fabrication of unstressed castings for the latest model of this engine, advantage was taken of the lightness of magnesium alloy and a saving of 17¾ lb. over aluminum has been effected.

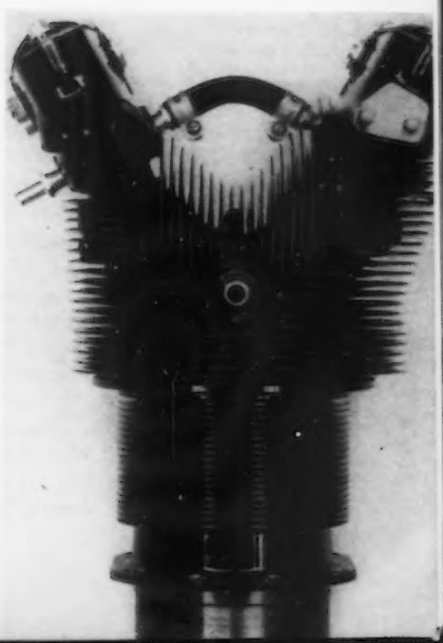
As a result of numerous tests by the National Advisory Committee for Aeronautics and manufacturers, much has been learned in the last year about the necessity of pressure air baffles between and behind the cylinders, under the various ring type cowlings, to improve aerodynamic performance of the airplane and to insure proper cooling of the cylinders. These are light metal stampings, conforming to the outline of the cylinder, fitted closely and are now in some cases furnished as standard equipment by the engine builder.

Ranging from the 1000-hp. engine to one only a twentieth that size, the industry finds the new light plane engine of 50 hp. developed during 1937 for this year's new sport planes by the Continental Motors Corp., Detroit and Muskegon, Mich.

Insofar as safety developments are concerned, this year seems to mark the introduction of the tricycle type of undercarriage. This kind of landing gear should increase safety by permitting safe landings with less skill, crosswind landings and take-offs, taxiing with visibility at least equal to that of a motor car and much less run on landing, with immediate and sharp application of brakes where necessary. There will be less danger of overturning the airplanes in a strong wind because the angle of attack of the wings will be less and the lifting forces set up by ground currents will be minimized The tricycle undercarriage has other advantages associated with transport operations. On big airplanes like the Douglas DC-4 the ship will always be in flying position, which means added comfort for the passengers, especially in the case of sleeper airplanes.

In the small plane category one manufacturer has combined the tricycle undercarriage, on a "tail-less" airplane, with a simplified type of control that eliminates most of the need for co-ordinating hand and foot motions in maneuvering the plane. This is the Waterman Arrowbile, powered with a Studebaker automobile engine. Quickly detachable wings and a declutched propeller make the plane capable of being driven like a regular passenger car on the streets or highway. Highly complimentary to the auto industry is the approval granted by the Bureau of Air Commerce after the engine had satisfactorily completed a 150-hr. test run at full throttle.





IMPROVED foundry technique has made possible much deeper and more closely spaced cooling fins on cast cylinders for air cooled aircraft engines. The cylinder above is the old type. That on the right has a total of 10 sq. ft. of fin area per cylinder, more than twice as much as previously.

Construction . . .

Private construction activity makes marked gains in 1937.

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By W. A. PHAIR
Associate Editor, The Iron Age

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TOTAL expenditure for all types of construction in 1937 exceeded the previous year by an estimated $234,705,000. This gain would have been much greater had not the promising development of the construction industries in the spring and summer months been stunted by declining business activity in the fall.

Breaking down the year's total of $2,910,000,000 covering construction contracts in 37 Eastern states, as collected by the F. W. Dodge Corp., it is seen that the largest gains over the preceding year, in the order of their importance, were made in industrial, commercial and residential buildings. Industrial buildings, reflecting the numerous expansion programs inaugurated by the metalworking industry, amounted to $323,000,000 and were 63 per cent over those of 1936. Commercial buildings totaled $310,000,000 and exceeded the 1936 figure by 23 per cent, while residential construction, at $937,000,000, was 17 per cent above the previous year's total.

The extent to which the recession in the autumn reduced building activity is clearly visible in a study of the monthly contract figures of the F. W. Dodge Corp. From a low of $188,257,300 in February, the volume of awards rose steadily to a high of $321,602,700 in July. From this point there was a steady decline, and in November the total was $198,464,600, or $123,138,000 below the year's high and only $10,207,300 above the February low.

The year 1936 was notable for the fact that in that year the dollar volume of private construction passed public construction for the first time since the pre-depression years. In 1934 public building accounted for 63 per cent of the total funds expended in construction work. This spread has grown smaller each year, until in 1936 the trend was turned about. In 1937 the ratio of 1934 was completely reversed and public buildings accounted for only 38 per cent of the total and private construction for 62 per cent. Middle chart on opposite page portrays the extent to which industry has taken up the slack.

1938 Total Probably Lower

Basing its figures on present indications, the F. W. Dodge Corp. estimates that construction activity in 1938 will be about 4 per cent below the 1937 total, as plotted on the chart on opposite page. One of the reasons for predicting a lower total for 1938 is the fact that private construction invariably follows the trend of corporate earnings and it will take at the very least the first half of 1938 to recover from the adverse influences of the autumn of 1937.

The steel industry is justified in being proud of the role it has played in the march to recovery. Data gathered from the records of the *Engineering News-Record,* covering heavy construction, as shown on page 84, in steel, automotive, railroad and public utility fields, show that the value of construction work in the steel industry rose from a depression low of $745,000 in 1932 to an estimated $119,611,000 in 1937, a figure in excess of the 1929 total. The expansion in the construction of new automobile plants, which started as early as 1934, took a tremendous stride in 1936 and settled down to a steady pace in 1937. The construction of new railroad facilities, as terminals, roundhouses, etc., has not gained in proportion to either steel or automobiles. For 1937 the estimated total of railroad building activity was $2,636,000 against a low of $712,000 in 1935. The unusual bulge in the graph line in 1933 was caused by the construction of a new freight terminal in New York by the New York Central railroad at a cost of over $3,000,000.

The upward movement of the chart covering public utilities and other power plants is attributable in a large measure to power plants built in conjunction with industrial plants. Even with industrial power plants included, the extent to which the power companies have lagged in reconstruction programs is clearly visible. In 1929 public utilities spent $151,033,000 on expansion programs. By 1930 this had shrunk to $1,741,000 and in 1937 the total advanced to $76,597,000, or half of the 1929 figure.

Data gathered by the American Institute of Steel Construction, covering 85 per cent of the fabricating capacity of the country, showed an increase in bookings in the first 11 months of 1937 of 5 per cent over the same period in 1936. Chart at bottom of opposite page gives comparison of total tons booked and price per ton for fabrication as compiled by the institute.

Analyzing the type of work represented by the institute's data, it is found that 38 per cent of the total went into industrial and commercial buildings, compared with 31 per cent in 1936. Government work showed a decline from 48 per cent in 1936 to 38 per cent in 1937.

The tonnage represented by small jobs of 50 tons or less accounted for

18 per cent of the total against 13 per cent in 1936. The volume of large jobs taking over 10,000 tons also increased, accounting for 7 per cent of the total in 1937 as against 2 per cent in the preceding year.

Much discussion of late has centered on ways and means of encouraging expansion and rehabilitation programs in the public utility field. Plans calling for expenditures of close to one billion dollars for the next three years are said to be under consideration by the nation's utility executives, but the indefinite policy of the Federal Government in relation to private power companies has made the future so uncertain that long range planning has been next to impossible. Recent conferences between utility leaders and various Federal officials suggest that differences are being ironed out and 1938 may see the floodgates lifted on this enormous building program.

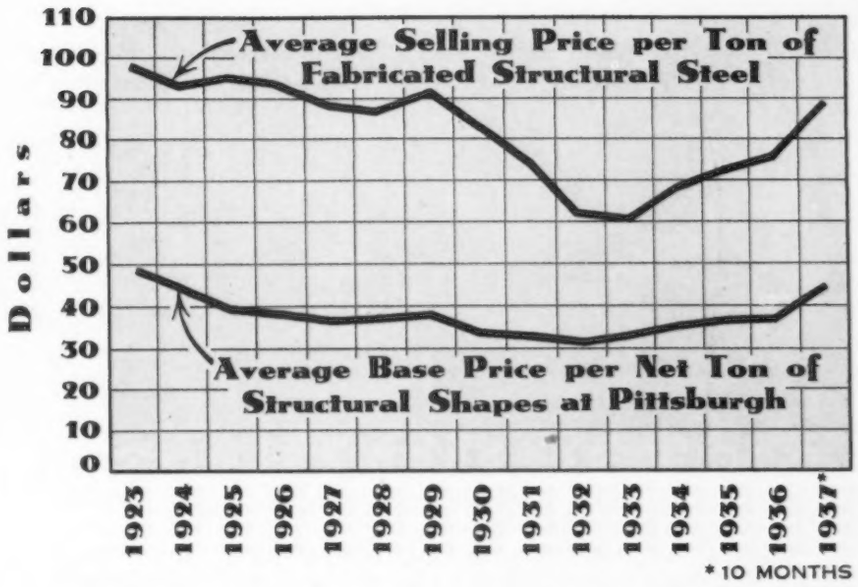
Housing

In 1929, the peak year of activity in the construction of non-farm dwellings, over 900,000 units were built. By 1934 this volume had shrunk to a negligible 55,000 homes. By gradual stages this total has worked upward and in 1937 the estimated number of homes built was 300,000. Housing facilities differ from other commodities as automobiles, clothes or refrigerators in that during depressions the population does not shrink, hence there is actually no lessening of demand, and the low level of activity from 1930 to date indicates that a tremendous backlog, put as high as 2,000,000 units by some authorities, has been built up.

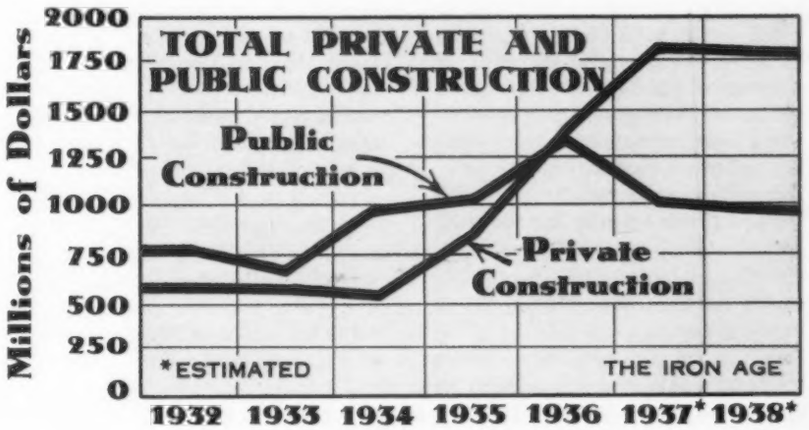
The extent to which residential construction has lagged behind the recovery of all other forms of construction is shown graphically in chart on page 85.

Stimulating house construction would not only aid in developing the building industry, but it would also assist in increasing the nation's revenue by adding to the taxable assets of the country. Because of this the Government and industry have devoted much attention over the past year to ways and means of encouraging the construction of new houses. These efforts have followed two general lines. First, making available ample funds at low interest rates for financing home building, and second, the development of low cost houses.

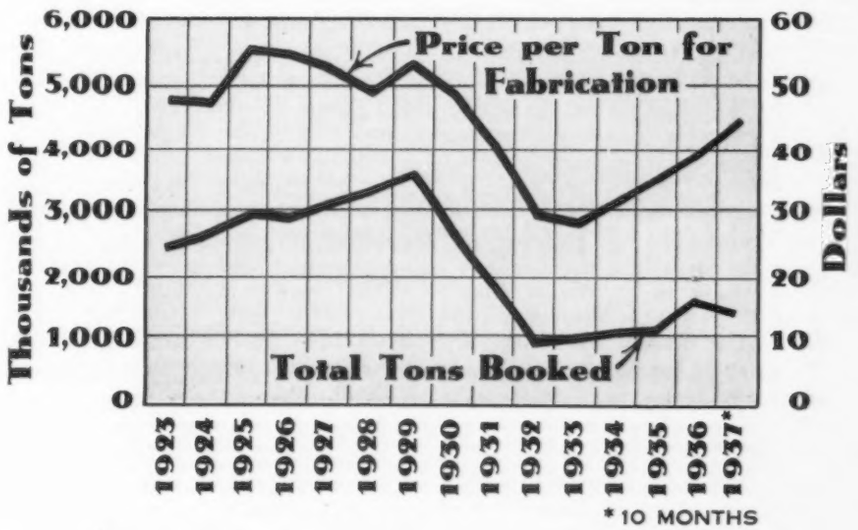
In the past a number of laws were passed liberalizing mortgage requirements and offering Federal assistance to persons desirous of building homes. These laws led to the growth of fly-



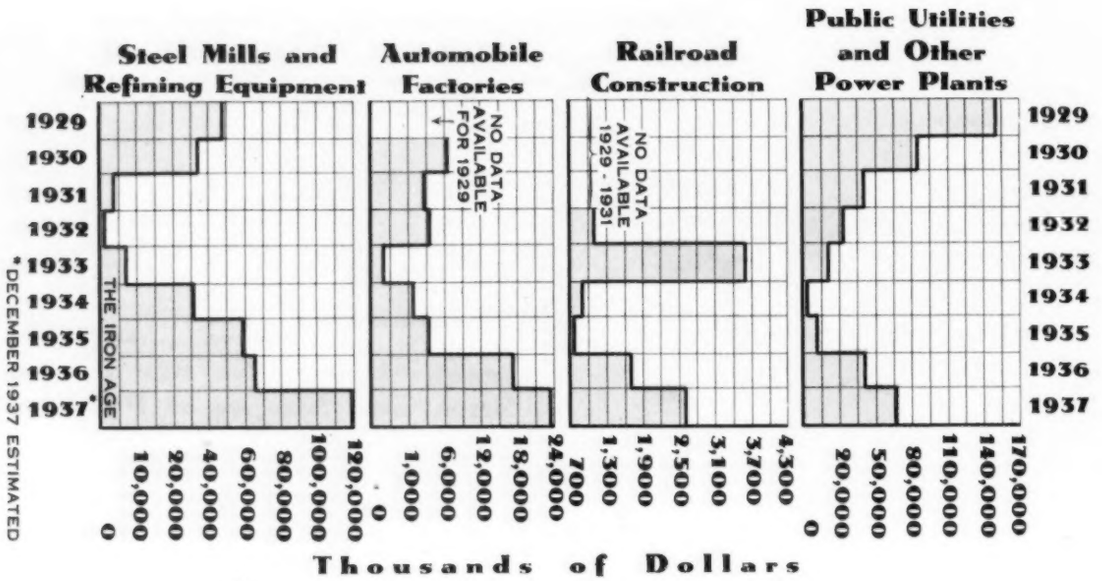
ADVANCING labor and operating costs have increased the spread between base price and delivered selling price of fabricated structural steel.



PRIVATE and public construction.



A COMPARISON of bookings and cost of fabrication of structural steel.



BUILDING activity in steel, automobiles, railroads and public utilities.

by-night builders to such an extent as to threaten the safety of the funds invested in such building. The consequence of this situation was the revamping of the Federal Home Loan Bank Board. The program of the new building board is to encourage sound, supervised construction; adherence to higher standards by builders and suppliers, and better security for the lending institutions.

Simultaneously with the revamping of the Home Loan Bank Board, much discussion has centered on plans to reduce the 20 per cent requirement on Federal financed mortgages to 10 per cent. In view of a recent survey on this question, it would seem that too much emphasis has been placed on the mortgage requirements. This mortgage study showed that only 57 per cent of the persons covered by the survey took advantage of the minimum down payment. The balance preferred to shorten the life of the mortgage by making a larger down payment. Another interesting result of this survey was the figures showing that between 60 and 65 per cent of the mortgagees took advantage of the 20-year clause. The rest preferred to amortize the loans in a shorter time. The conclusion to be drawn from these figures is that the down payment is not a major obstacle confronting a revival of home buying. The problem is, apparently, that of the overall cost. If the overall cost of houses could be brought down to the point where the carrying charges would be within the means of the masses, then unquestionably the way for a building boom would be open.

This need for low cost homes was emphasized in the recent report on housing conditions made by the National Housing Committee. The committee's report stated that at present there exists a demand for over 2,000,000 dwellings for families paying $30 or less rent per month.

To fill these requirements and to keep up to the "normal" demand would require the construction of 1,503,853 houses each year for the next two years. Of this total 66 per cent would have to cost $2000 or less; 22.8 per cent would be required in the price group ranging between $2000 and $3000, and 3.4 per cent in the $5000 price range.

Steel Houses

A new steel house built to sell for $2400 was announced last fall by Steel Buildings, Inc., Middletown, Ohio. These houses are built with steel walls and panels and may be set up on a foundation with all lighting and plumbing equipment installed ready for occupancy for less than $3000. These homes are available in a number of attractive styles, one of which is illustrated, and were designed to supply those in the $1000-a-year income class with a sturdy, livable home. The amount of steel used in these houses varies from 2800 to 4100 lb.

Taking inspiration from the automobile industry, where mass production took the automobile out of the luxury class and put it within the reach of the average man, many organizations have endeavored to design a steel home that could be fabricated on an assembly line, shipped in sections, and erected on the site with common labor.

The path of the pioneers in this field has been beset with many obstacles, chiefly that of acquainting the public with the virtues of steel construction and developing distributer outlets. Much of 1937 was devoted to study of these problems, and the results of these studies will undoubtedly be of great value in future years in guiding the course of steel houses in America.

The amount of steel consumed in building steel houses is practically impossible to estimate owing to the many different methods used in marketing the houses. Several organizations furnish only the basic structural parts of a house. The exteriors are finished with the customary building materials. The amount of steel per house used with this type construction averages about two and one-half tons.

Other organizations, notably the Stran Steel division of the Great Lakes Steel Corp., sell prefabricated sections in the same manner as lumber—through lumber dealers. Estimating the tonnages involved in a house of Stran Steel sections is further complicated by the fact that a substantial amount goes into small standardized buildings as lunch rooms, gasoline stations, etc. The smallest standardized Stran Steel house takes two tons and the largest 25 tons.

It is equally difficult to attempt to prognosticate the future consumption of steel by this industry. A very crude

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NEW low-cost, all-steel house developed by Steel Houses, Inc.

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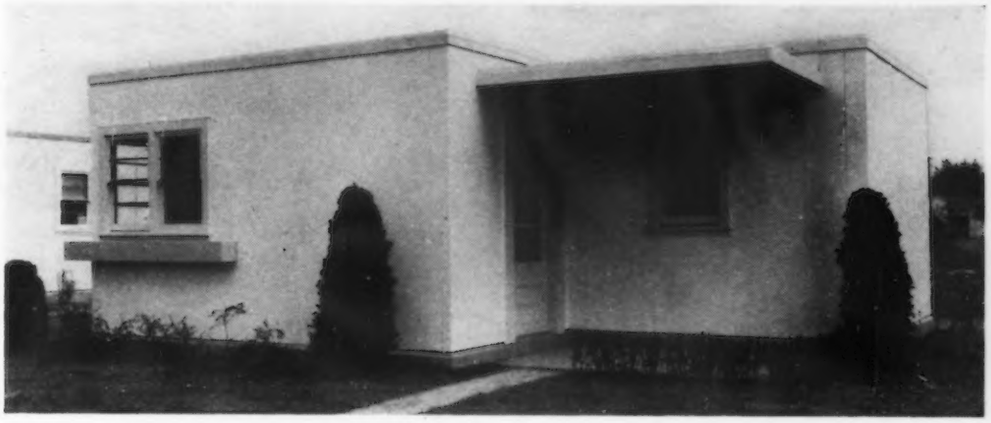


estimate could be arrived at by determining what proportion of the number of houses built yearly of wood frame construction might be supplanted by steel houses, and then multiplying the result by the average number of tons used in an all-steel house. However, at its best such a figure would be little short of a wild guess and it would be preferable to wait until this field assumes more definite form.

Grade Elimination Grows as Steel Outlet

Grade elimination programs have grown steadily in number and size, and with this growth has come increased use of steel, particularly reinforcing bars, in this type of construction.

In the first six months of 1937 $30,000,000 was spent by the Federal Government on grade elimination projects. An additional $60,000,000 has been earmarked for approved jobs, and $40,000,000 still remains available for future use.

State governments have been very active in this field in 1937, many states duplicating the recent action of New York in underwriting a $10,000,000 bond issue solely for grade elimination work. The continued growth of the express highway should see this market expand to important proportions.

Another phase of highway construction that promises to grow into a heavy consumer of structural steel is the elevated highway. Several cities, notably New York and Chicago, have built elevated roads and have met with considerable success in reducing accident rates and at the same time expediting the movement of traffic through congested areas.

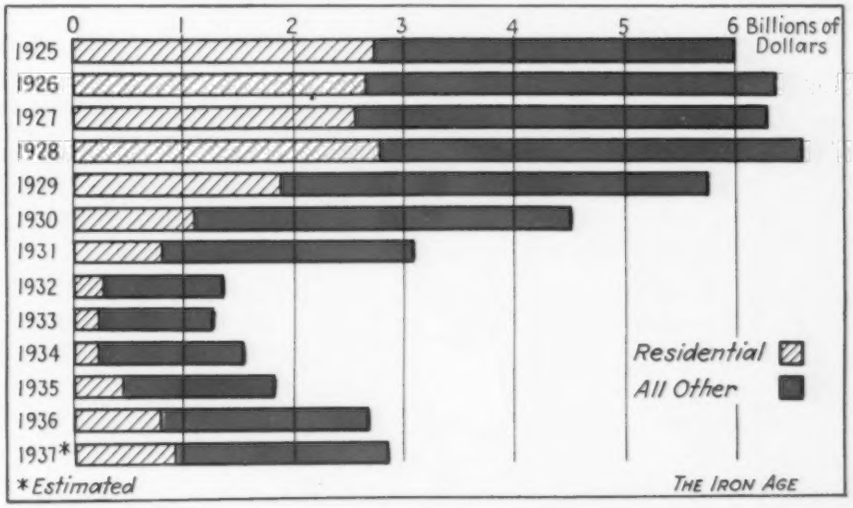
To focus attention on the possibilities of this type of structure, the American Institute of Steel Construction has inaugurated a national competition for the most suitable structural and architectural design of an elevated highway. Awards totaling $9000 will be given to the winning competitors.

Use of Welded Construction Gains

To industry, the strength and efficiency of welded construction are well known, but to the non-technical legislative bodies that must approve changes in the building codes of the nation's cities, a certain aurora of mystery surrounds welding processes, and they have been slow to authorize its use in supervised building construction. Credit for the gradual correction of this attitude must be given to the welding industry and to trade associations for their work in disseminating information on this subject.

New York and Chicago are the latest additions to the growing list of cities sanctioning the use of fusion welding in building construction. Both these cities permit the substitution of fusion welding for riveting, but place restrictions around the circumstances under which it may actually be used.

The revised building code of New York is also noteworthy because it takes cognizance of the increased use of alloy steels in building construction and includes, for the first time, specifications covering allowable working stresses for silicon and nickel steels, which are 24,000 and 25,500 lb. per sq. in respectively. Permissible stresses in structural steel in the new code were increased from 16,000 to 18,000 lb. per sq. in. in recognition of the greater strengths developed in modern steels. According to the American Institute of Steel Construction, 183 cities have adopted the use of the 18,000 lb. working stress for structural steel, while an additional 83 cities permit its use under certain conditions. In 1936 the institute adopted a new structural steel specification with a 20,000 lb. basic working stress. Since its introduction, 171 cities have adopted the 20,000 lb. specification and 109 permit its use under specified circumstances.



RESIDENTIAL construction compared with all other types.

Lionel Green

MANY farms like this still exist, pointing to the large potential markets for improvements when the farmer is prospering.

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NINETEEN THIRTY-SEVEN has gone down in the records as the greatest year in history for manufacturers of farm equipment and the second best year for the farmers themselves. Only in 1929, when the farm income totaled 10,479 million dollars, has the nearly nine billions estimated for 1937 been exceeded. Compared with 1936, this figure represents an increase of over one billion dollars.

Since sales of farm equipment always vary proportionately with the rise and fall of farm income, it was to be expected that 1937 would be a big year. One needs only to look back over the long, lean depression years when few farms were provided with new implements or tractors to understand why the record set in 1929 was surpassed even though income was greater. It was the tremendous backlog of needs built up during these years that brought 1936 up to the standing of an average year for the industry, made 1937 a record-breaking period, and is causing the Department of Agriculture, assuming satisfactory crop conditions and prices, to forecast the possibility of 1938 production and sales of farm machinery being greater than either 1937 or the 1925-29 average.

Wholesale sales in 1936 amounted to 409 million dollars, within 11 per cent of 1929 sales, whereas, according to the Department of Agriculture in November, 1937, "Manufactures' sales of farm machinery are expected this year to exceed those of 1936 by 30 or 40 per cent," which will mean a total of 530 million or 572 million dollars. These figures compare with the all-time previous peak attained in 1920 of 471 millions and 458 millions in 1929. Exports of agricultural machinery and implements excluding tractors, totaled 57.3 million dollars in 1937 compared with 32.8 million in 1936. The increase in total sales was principally due to the great demand for tractors, which has never before even been approximated.

Other than the sale of their products, important factors that added to the farmers' cash position and consequently aided in setting this all-time high figure for equipment sales were Government payments, which were estimated at 425 million dollars for the year as compared with 287 millions in 1936, and declining taxes and interest payments.

After operating at near capacity throughout the year, tractor and implement plants are entering 1938 with order books still well filled, and with an estimated one billion dollars of deferred depression buying still before them. Good business throughout the first half of the year is almost assured, but what may come thereafter is largely problematical, since the second half always depends on crop prospects, prices and current economic conditions. Higher production expenses and less demand may scale down next year's income somewhat, but machinery sales are expected to be good unless farm income decreases substantially.

The drop in security prices, which

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Best year for makers of farm equipment and next to the best year for farm income are the marks chalked up by 1937.

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By R. G. BINGHAM
Western Editor, The Iron Age

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seems to influence most businesses to some extent, large or small, apparently has bothered the farm regions but little. Buying of tractors and implements has gone right along, regardless of the huge stock market losses, and for the past few months the activity of the farm equipment industry has been such as to make its demand for steel a large factor in the production from week to week. Always an important consumer of shapes, plates, bars, wire, sheets and strip, the industry so increased its steel orders that for a time it became much more important, in relation to railroads, construction and automobiles, than ever before.

Although operating expenses, such as labor, taxes and cost of materials, were greatly increased during 1937 for makers of farm equipment, the lower unit costs resulting from the high rate of operations made it possible to show a profit without substantially increasing prices. The Department of Agriculture expects a price boost in 1938, however, because of these increased costs.

Farm Buying Power Greater

Buying power in 1937 was high at the beginning of the year but gradually was reduced as the high prices received by the farmers for their products in January and in the spring were lowered. The following table prepared by the Department of Agriculture uses the period 1910 to 1914 as 100 and shows the relationship of prices paid to those received and the consequent buying power:

1937	Prices Received	Prices Paid		Buying Power
Jan.	131	130		101
Feb.	127	132		96
Mar.	128	132		97
April	130	134		97
May	128	134		96
June	124	134		93
July	125	133	preliminary figures	94
Aug.	123	132		93
Sept.	118	130		91

Income to farmers in some of the West North Central States, where in 1929, one-third of all the farm equipment was owned, showed a loss when compared with 1936. The chief reason for this decrease was a carryover into 1937 of the effects of the 1936 drought, lower yields resulting but not a complete crop failure. Sales of livestock were also lower because of the feed shortage and resultant heavy movement of cattle from this region. The Dakotas, Nebraska and western Iowa were mainly affected.

Important contributing factors to the prosperity of the farm machinery industry in the 12 months just past, aside from the high farm income and the large volume of unfilled needs that accumulated during the depression, were high crop prices, and the shortage of farm labor.

The first of these—high prices for wheat, corn and other grains—was an influence not only as it added to pocketbooks, but because the farmers in their haste to market their crops so as to take advantage of these prices bought new machines to aid them in getting out their harvests. Much of

GIANT smart weeds 7 to 8 ft. in height being plowed under by Case tractor and tractor plows.

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ABOVE

ONE reason for last year's great demand for tractors—their utility. A rubber-tired model is here shown providing power for threshing.

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AT RIGHT

IN great demand during 1937 were tractor attachments, a two-bottom tractor plow being pictured here.

the heavy backlog of orders built up by the industry throughout the summer was caused by this almost instantaneous demand, which forced long extensions of deliveries.

Labor Saving a Factor

Labor had its effect in that most of those available for hire proved unsatisfactory and undependable, causing the farmer to prefer machines for preparing and harvesting his crops. Also of importance was the increasing desire among those owning and operating farms to become independent of others than family help, in order to do away with the necessity of hiring and feeding outsiders to help harvest. The cost of hand picking and husking corn averaged 7c. a bu., meaning that a 70-bu. yield on a 100-acre farm would cost the farmer $490, or approximately the cost of a corn picker, which is able to pick 16 to 20 acres a day under average field conditions, as compared with not more than one acre of 70-bu. yield, if that, by hand. Machinery was additionally valued because of the safeguard provided against slow hand labor delaying the harvest until the arrival of bad weather.

Other advantages of this mechanical picker are that more corn is obtained because the machine will get the ears on down and leaning stalks and also pick the small ears and nubbins. Cleaner husking is also accomplished. The two-row picker enables the farmer to go into his field anywhere and pick two adjacent rows without going over unhusked corn rows.

As an example of the sudden rush for this type of equipment, it has been estimated from inquiries received by manufacturers that 40,000 corn pickers could have been sold during the summer, whereas production facilities could provide only 10,000, thus leaving unsatisfied fully 75 per cent

of the demand. In one town in Iowa where a sale of 40 corn pickers was estimated in the fall of 1936, this figure was doubled to 80, and then redoubled to 160, and still orders poured in, until at the end of the season it was found that 400 could have been sold, although they were given only 120 by the manufacturer.

Tractor Sales Grow Steadily

The big crop, of course, was the chief reason for the unprecedented demand for corn pickers, but also a factor was the growing tendency toward the use of more and more power equipment. In one Iowa county, 80 per cent of the corn crop is estimated to have been harvested by mechanical pickers, of which 1300 were sold in the State during 1936, and of which Iowa has more than 6000 in operation.

Another big item last year, both in adding to backlogs and in adding to sales income, was the popularity of the tractor, especially the all-purpose type, which accounted for approximately 75 per cent of the tractors sold where not over five years ago the percentage was only 30. An increasing disposition has been noticed among farmers to equip their farms with tractors and tractor-operated machines. Since 1922, when tractors accounted for 22 per cent of the total of the wholesale value of all farm equipment sold in the United States, the tractor percentage has continued to rise almost without interruption. In 1936, tractor sales accounted for 42 per cent of the total volume, and it has been estimated that if sales of other machines which depend upon the tractor for operating power were added to tractor sales, more than one-half of the farm equipment industry's total sales would be represented by this type equipment.

A major development in 1937 was the proving of a market for the small tractor designed for use on farms of 50 acres and less. Formerly these farms were not regarded as tractor prospects because of the limited amount of power required in their operation. The introduction of the small tractor, however, with a smaller initial investment and a consequent lower power requirement for economical operation, may materially change the situation with respect to these smaller farms, according to a study prepared by Harry G. Davis, director of research, Farm Equipment Institute, Chicago. It seems reasonable to believe, Mr. Davis says, that enough farms smaller than 50 acres will some day use tractors to offset those larger farms where topographical conditions prohibit the economical operation of tractors. Manufacturing was mainly on an experimental scale last year but plants already are being tooled for the production of these small tractors in 1938.

Half of Tractors Over Seven Years Old

Mr. Davis has estimated that about one-half of the tractors on farms are seven or more years in age, which would indicate that replacement sales for the next few years should be high.

The 1935 census reveals about 2,700,000 farms of less than 50 acres, on many of which the power load is not enough to justify an investment in the lowest priced tractor that was on the market before the present smaller types were introduced. Many, however, are able to accommodate the

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AT LEFT

TWO men, plus grain haulers, operate this harvester-thresher cutting a 12-ft. swath, which is pulled by a deisel-powered tractor. Capacity is 50 acres daily.

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AT RIGHT

TRACTOR - OPERATED 2-row potato digger harvesting seed potato crop near Merrill, Ore. Notice the use of rubber tires.

o o o

Lionel Green

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MECHANIZATION of farming has not as yet abolished the familiar "hay burner."

o o o

small tractor and use it to their profit, and have done so.

Large farms will now find a use for the small tractor as an auxiliary machine in addition to the big tractor. It has been found profitable to use the small tractor for cultivating, making hay and other light jobs, while using the larger machine for plowing, disking and other heavy work. A small tractor can be purchased for about what it would cost to turn in a conventional size tractor on an all-purpose tractor of a like size, thus giving the operator the advantage of two power plants that can be used simultaneously, and providing him at the same time with an economical power outfit.

Rubber Tires Popular

A leading manufacturer reports about 50 per cent of the tractors sold are on rubber tires, while official census figures disclose 31 per cent of the wheel type tractors made in 1936 were rubber-tired as compared with only 14 per cent in 1935, an increase in one year of more than 100 per cent. A major development along with this swing toward rubber-tired tractors and field machinery is the appearance of mowers, planters, cultivators and harvesting machinery that may be quickly attached to tractors. These quick attachable machines are often in larger units than those previously purchased by farmers and are made to operate at higher speed and to be operated by one man, thus further relieving labor requirements.

Although the wheel-type tractor, whether on rubber or steel, is the most popular with the farmer, in 1936, approximately 30 per cent of the industry's total domestic tractor sales of $140,643,385 was accounted for by track-type tractors, a larger proportion of which are used industrially than in the fields.

Foreign Demand Gained

Foreign commerce in tractors for the first nine months of 1937 showed practically a 100 per cent increase over the corresponding period of 1936, 30,378 tractors having been shipped out of the country last year as against 14,881 in 1936. The value in 1937 totaled 33.6 million dollars as compared with 17.2 million the previous year.

Introduction of small models in combines has also proved profitable, since the smaller farms in the Middle West, especially those producing soy beans and wheat, have accounted for a large proportion of the huge demand for this type of equipment. The use of this miniature combine which cuts a five to seven-foot swath is said by soy bean growers with small farms to be the only means by which their crop can be harvested economically.

FARMALL tractor and 2-row cultivator which cultivates about 20 acres a day on this truck farm in Oregon.

Tractor-plows and side delivery rakes with gears and clutches running in oil have been especially well received.

Manufacturers report that farmers are showing a great preference toward carefully designed, well-built machines which will last a long time, rather than for those that may save a few dollars at the outset but may require considerable upkeep or replacement within a short time. In the past few years there has, of course, been a great swing from cast iron to steel construction in the building of farm machinery, an increased use of welding, anti-friction bearings, and dust-proof construction.

The extension of rural electric lines was an important factor in advancing the sales of farm power equipment, although the sale of farm engines apparently has not suffered.

An increase in the use of home water systems and lighting plants on the farm has come about as a result of the combination of higher income and a desire for better living conditions.

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MANUFACTURERS were wholly unable to meet the demand for the two-row corn picker shown here mounted on a tractor. Under normal conditions, this machine may be operated at 3 miles an hr. and picks from 16 to 20 acres a day.

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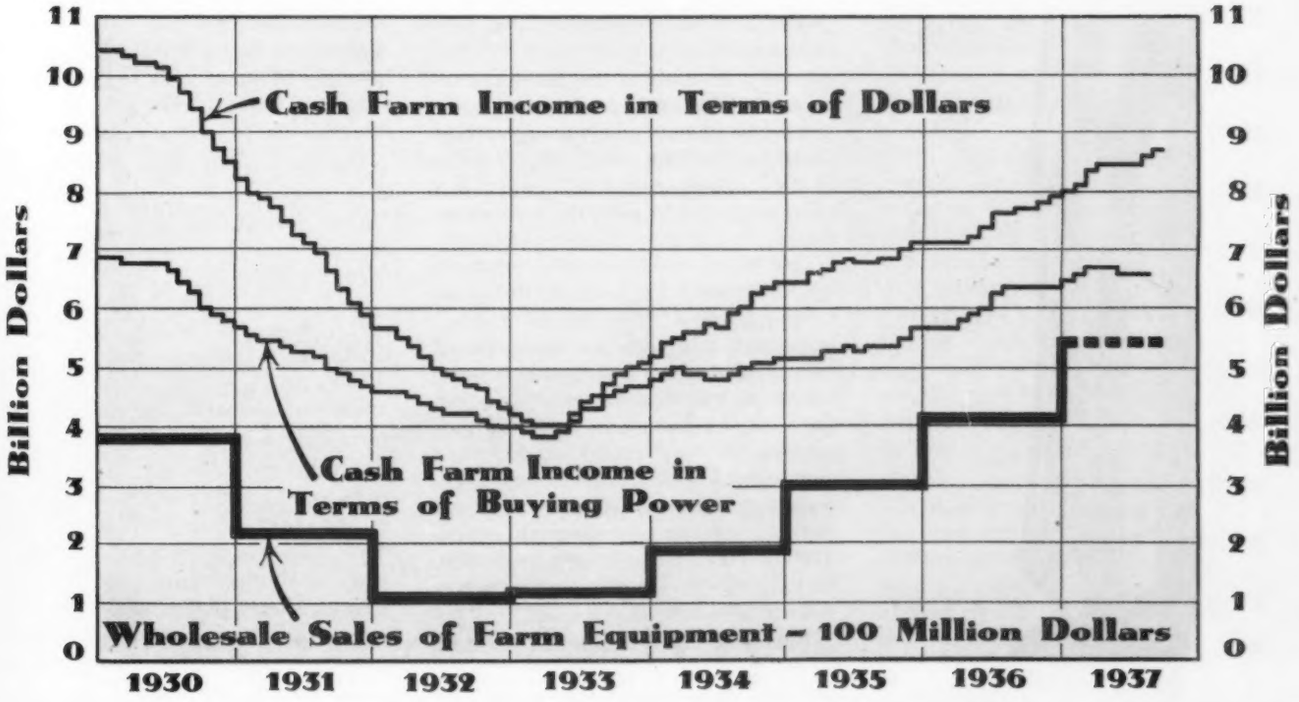
TOTAL cash farm income by months is represented by the steps indicated in the top line, while the ones immediately below it show the buying power of this income based on Government index figures on costs of commodities used by agriculture for living and production. Prepared by Harry G. Davis, director of research, Farm Equipment Institute, this chart has had superimposed upon it the annual wholesale sales of farm equipment based on census figures except for the years 1932 to 1934, inclusive, and 1937, which are unofficial estimates. This addition to the chart is especially valuable because it shows the close relationship between farm income, buying power and equipment sales.



World

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IN these captious, emotional and introversive United States the capital goods industry has been more than a little dazed by erratic attempts to bluff the depression, only to end up by wrestling with a recession. Seeing a new high record for steel production slip out of its grasp during 1937, the industry has on occasion rubbed salt in the wounds by envying the steady production expansion in foreign countries. But an examination of the world's steel production statistics, sans imagination, fails to disclose much cause for envy. Other countries certainly appear to be sweating over domestic production problems of their own, and many countries all too frequently are giving a fillip to their steel output by piling up armaments. Therefore, the final chapter of the comparative picture cannot be accurately written until someone calls someone's bluff and all the steel is liquidated on battlefields, or until armament programs are tapered and consumer markets are forced to absorb a great deal more steel. Another discouraging feature in the world picture is the way export markets are seemingly destined to freeze up. Nations heretofore outlets for steel are buying American or German equipment, building up their own industries, and gradually cloaking themselves with import restrictions.

From the coldly statistical point of view, the year 1937 walked off with the steel maker's blue ribbon. World output of steel ingots and castings topped 131,000,000 gross tons, a new record, and one which bettered the previous high year of 1936 by 9,575,000 tons, or almost 8 per cent, and was 12,925,000 tons, or 11 per cent, above the pre-depression banner year of 1929. Whereas steel output in both 1936 and 1937 topped the 1929 level, pig iron output in 1937 for the first time passed 1929 to establish a new record year. Total pig iron production (and ferro-alloys) in 1937 was 101,547,000 tons, being about 12 per cent greater than 1936 production and 4,137,000 tons, or 4 per cent, above the previous record year of 1929. This phase difference—the lag of pig iron production in relation to steel production—is entirely typical during an ascending period, and, also, is always apparent during a descending period (the lag is usually about six months).

Of course, the United States continues to account for the bulk of the world's steel. Of the total ingots produced, this country turned out 37.69 per cent (slightly less than in 1936), and of the total world's pig iron this country accounted for 36.73 per cent (slightly more than 1936, due to exports). Germany and the U.S.S.R continue to tussle for second place in both pig iron and steel, with Germany retaining her advantage by a slight margin.

During the depression decline in steel production over the world, the United States of all countries fell off most drastically, as is generally known here. The recovery process in this country likewise has shown the sharpest fluctuations, mostly because of changing governmental policies. Nonetheless, it is well to remember that armament demands in this country form only a small proportion of total demands, and also the steel industry is geared to far greater capacity than in any other country. Thus it is evident that this country's steel production, albeit fluctuating, has been fed into consumer goods more so than in any other country, and consequently may be considered as having a far more constructive value.

Next to the United States, Germany,

Output

o o o

BY T. W. LIPPERT
The Iron Age

o o o

World steel and pig iron production reaches new high levels as consumers throw off depression inertia and as nations build up their armaments.

the world's second largest producer in 1937 (14.76 per cent of the steel, 15.47 per cent of the pig iron), experienced the sharpest depression decline. Its return to the pre-depression level was practically completed in 1936, and production in 1937 showed only a moderately rising trend. However, in Germany consumer goods outlets have (and are) been bled without mercy so as to pamper military construction, and there is some justification for doubting whether the German people would have enough buying power to support the current production rate were armaments to be minimized in favor of consumer goods. Nevertheless, Germany is feverishly expanding mining facilities (government exploited), is increasing pig iron and steel output (U. S. engineers have contracted to build three entire plants, at Salzgitter, Bavaria and Baden), and became the proud owner in 1937 of her first continuous sheet mill, a 55-in. American unit at Dinslaken, rated at 500,000 tons yearly. A second American wide strip mill is planned at Neunkirchen, which would probably lift continuous mill output to 1,250,000 tons yearly, this tonnage being practically equal to Germany's total output of tin plate, sheet and strip. Thus it seems that Germany is mimicking America's substitution of continuous units for uneconomical hand mills.

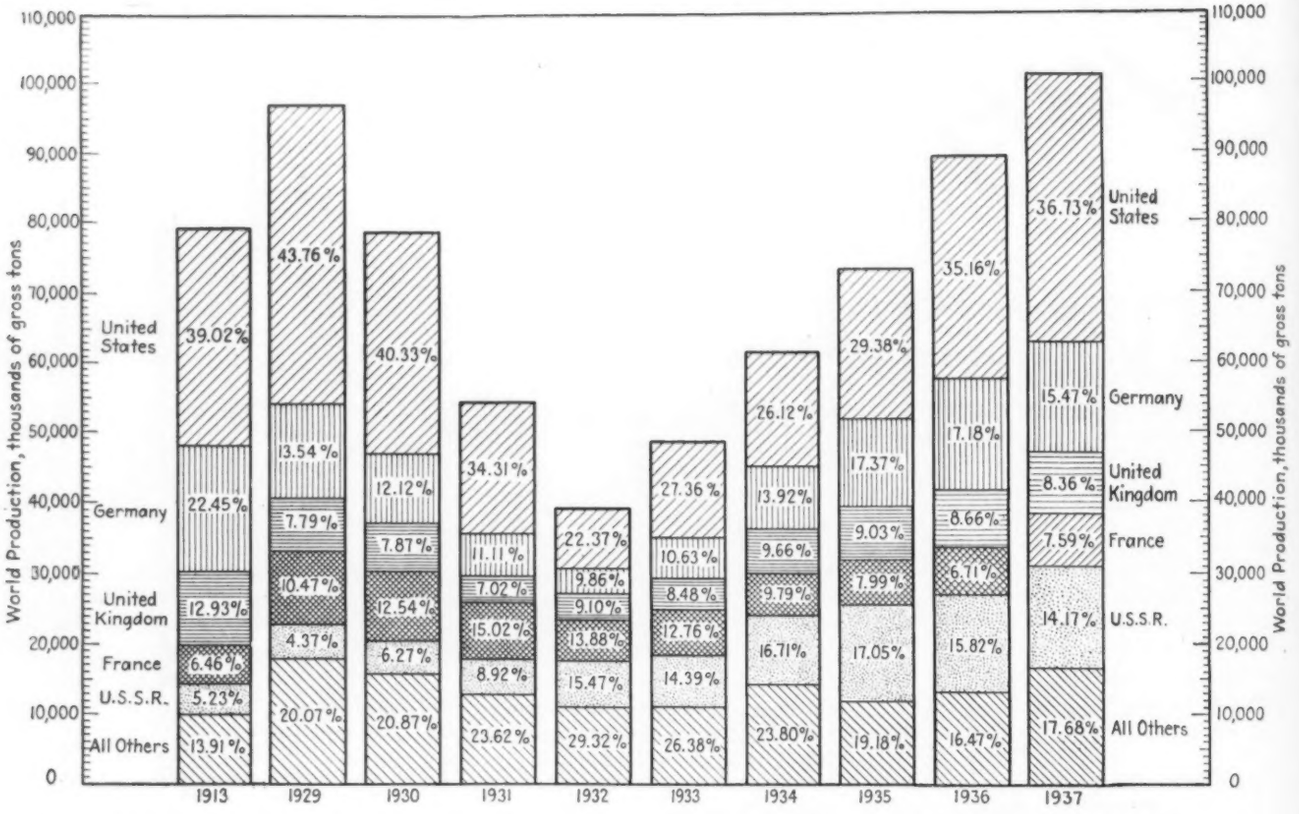
The U.S.S.R. failed to meet its prophecy of passing Germany in 1937, and for the year remained in third place (13.14 of the world's steel, 14.17 of the pig iron). Nonetheless, the U.S.S.R. growth in steel has been well-nigh fabulous, increasing sixfold from 1927 to 1937. During the world recovery from the depression (1932-37) the U.S.S.R.'s increase in steel production paralleled that for the rest of the world, meaning that it built new plants and trained unskilled workers at as fast a pace as other countries were able to reopen existing plants and call in trained workers. Despite this excellent record, the U.S.S.R. planners are bitterly disappointed over their failure to meet 1937 estimates; they fell short by 2,000,000 tons of pig iron and 3,000,000 tons of steel. This failure has greatly interfered with the Soviet armament program, and is attributed primarily to inadequate fuel supplies. To remedy the situation Mr. Stalin is divorcing the engineering industry and the People's Commissariat for Heavy Industry and has struck from the payroll a large number of saboteurs. Therefore, unless executive caution paralyzes the industry, the U.S.S.R. in 1938 will quite likely press on the United States' flank as the world's second steel producer.

Great Britain's steel industry established new high records during 1937 for both pig iron and steel, this activity being directly traceable to her rearmament program. Rearmament pressure in Great Britain, of course, assumes a much greater emphasis in the steel industry than it would in the United States; for Great Britain is comparatively a picayune steel producer (9.86 of the world's steel, 8.36 of the pig iron), and at capacity operation can turn out no more than the United States operating at a depression level of 17 per cent. The tremendous pressure for steel in Great Britain is gradually easing, and in 1938 there probably will be considerable steel available for export, that is if Great Britain can compete with the export price policies of Germany and Japan.

France and Belgium both had a comparatively poor year in 1937, and of all the countries these two compare today most unfavorably with 1929 activity. This poor showing is mostly attributable to monetary difficulties and hastily introduced labor legislation such as a 40-hr. week, the latter being particularly prominent in France. In contrast to many other large steel producing countries, the production of which is based on domestic coal and imported ore, French industry is based on domestic ores and mostly on imported coal, and normally shows a surplus production of pig iron in relation to steel. The Soviet took some of this surplus from France in 1937 rather than from Germany, but nonetheless the French situation was technically and economically difficut during the year and served to restrict the recovery cycle.

Now that Mussolini has had his way with Ethiopia, Italian steel production statistics are again being released. The 1937 output approximated 2,100,000 tons, which was somewhat less than the record level of 2,174,000 tons established in 1935 (during the Ethiopian invasion). Like other small militaristic nations, Italy is now surveying the steel industry with complete self-sufficiency in mind, although the plan is difficult in view of the poor domestic reserves of coal and iron ore. So far Italy has been unable to squeeze Britain out of the rich Spanish iron ore fields, and she may never do so in view of the excellent relations between British industrialists and General Franco. At home, Italy is in the throes of a three-year development plan for electric steel, exploitation of low-grade coal and iron mines and systematic scrap collection, and fully expects to reduce steel, scrap and raw material imports 60 per cent by 1941.

Japan, emulating Italy, has been withholding production statistics ever since the initial Chinese invasion during the summer. However, accurate estimates would place Japanese output of steel for 1937 at 5,480,000 tons, a new high record. Japan, like Italy, must import raw materials, and like Italy she is feverishly trying to correct this situation, both through home



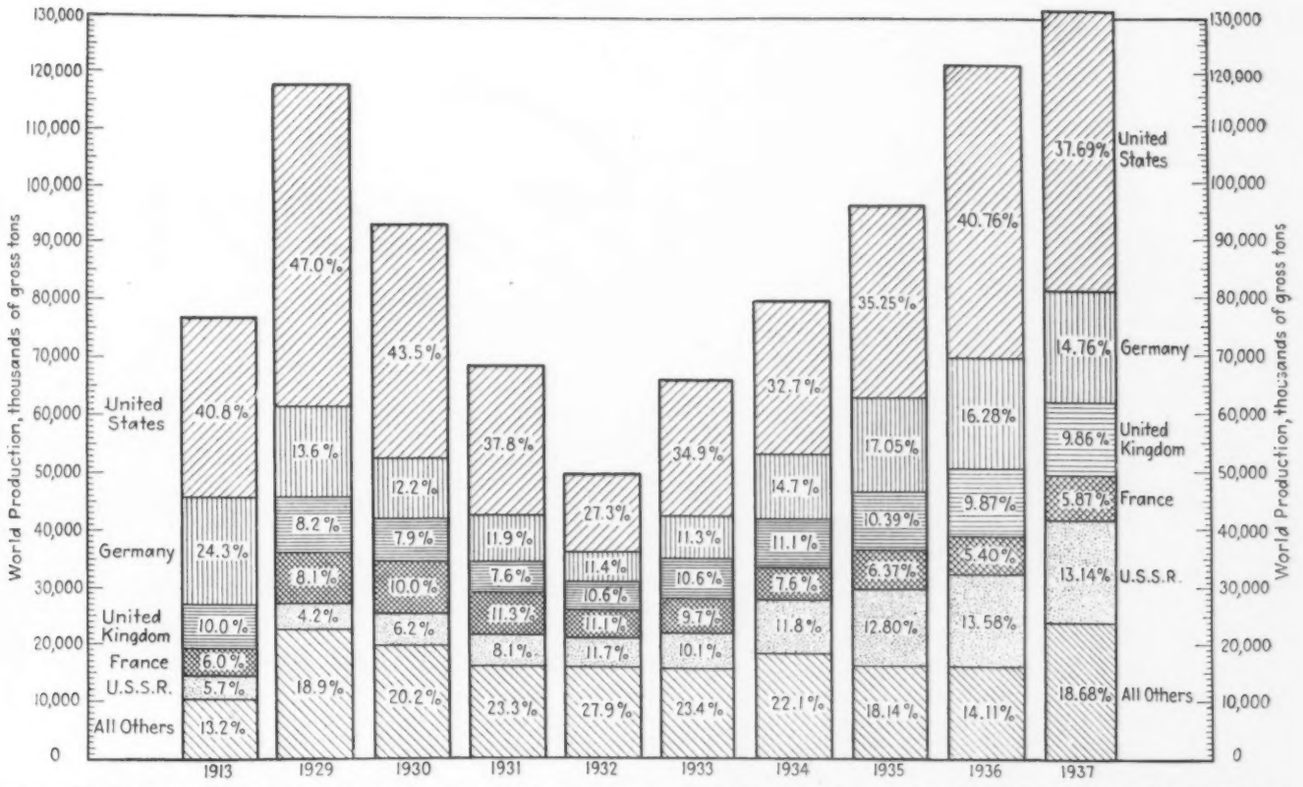
WORLD PRODUCTION OF PIG IRON—PERCENTAGE OF TOTAL FOR LEADING PRODUCERS.

development, the purchase of ore mines in British colonies (Australia and Canada), and the imposition of friendship on the Chinese, who have raw materials. There has been much furor here about Japan's importation of American scrap (pig iron imports are also high). However, Japan has so much new pig iron capacity under construction that in a year or so she may willingly forsake United States markets for raw materials and counter with some stiff competition on finished steel in the export markets of South America and elsewhere, or may even come through the American tariff wall. Japan normally imports only 1,000,000 tons of pig iron from the entire world. The Showa Seikosho works in Manchuria has, however, just completed a blast furnace of 700,000 tons yearly capacity, using local ores. And under a grandiose five-year plan, the Japan Iron Mfg. Co. has scheduled for construction five new blast furnaces (in Japan) with a total annual capacity of 1,250,000 tons, and 11 open hearths of a yearly capacity of 300,000 tons. Now that Japan has made the Chinese friendly,

WORLD PRODUCTION OF PIG IRON (Thousands of Gross Tons) (Including Charcoal Iron and Ferro-alloys)

	1913	1929	1930	1931	1932	1933	1934	1935	1936	1937†
United States	30,966	42,614*	31,752	18,426	8,781	13,346	16,139	21,373	31,029	37,300
Germany	16,493*	13,277	9,540	5,966	3,870	5,183	8,602	12,637	15,058	15,706
U.S.S.R.	4,149	4,251	4,937	4,798	6,078	7,017	10,327	12,501	14,187	14,375*
United Kingdom	10,260*	7,589	6,192	3,773	3,574	4,136	5,969	6,424	7,721	8,492
France	5,124	10,198*	9,874	8,068	5,448	6,223	6,053	5,696	6,130	7,708
Belgium	2,445	3,976*	3,311	3,147	2,705	2,667	2,906	2,982	3,156	3,459
Japan‡‡	239	1,536	1,660	1,399	1,542	2,022	2,385	2,773	2,870	3,306*§
Luxemburg	2,507	2,860*	2,433	2,020	1,929	1,858	1,924	1,842	1,955	2,500
Czechoslovakia	††	1,619	1,417	1,146	443	491	590	799	1,122	1,621*
Saar	**	2,071*	1,881	1,491	1,327	1,567	1,797	**	**	**
Canada	1,016	1,169*	812	466	160	258	440	655	747	962
Italy	428	715	572	533	481	545	565	683	793	831*
Poland	1,015*	693	470	341	196	301	380	388	575	669
Sweden‡	730	516	488	411	277	340	549	603	621	658
Spain	418	741*	595	468	291	323	450	335	218	210§§
All other countries‡‡‡	2,110	3,585	3,306	2,747	2,018	2,193	2,864	3,409	4,008	3,750
Total	77,900	97,410	79,240	55,200	39,120	48,470	61,940	73,100	90,190	101,547*

† December estimated. * Highest yearly production. ** Included in Germany. †† Part of Austria-Hungary. ‡ Highest yearly production = 842 in 1917. ‡‡‡ India and Australia account for almost half this total. ‡‡ Includes Korea and Manchuria. § Japanese statistics suspended by Government on July 1; total shown is an accurate estimate. §§ Data not available; total shown is primarily a blind guess.



WORLD PRODUCTION OF STEEL INGOTS AND CASTINGS—PERCENTAGE OF TOTAL FOR LEADING PRODUCERS.

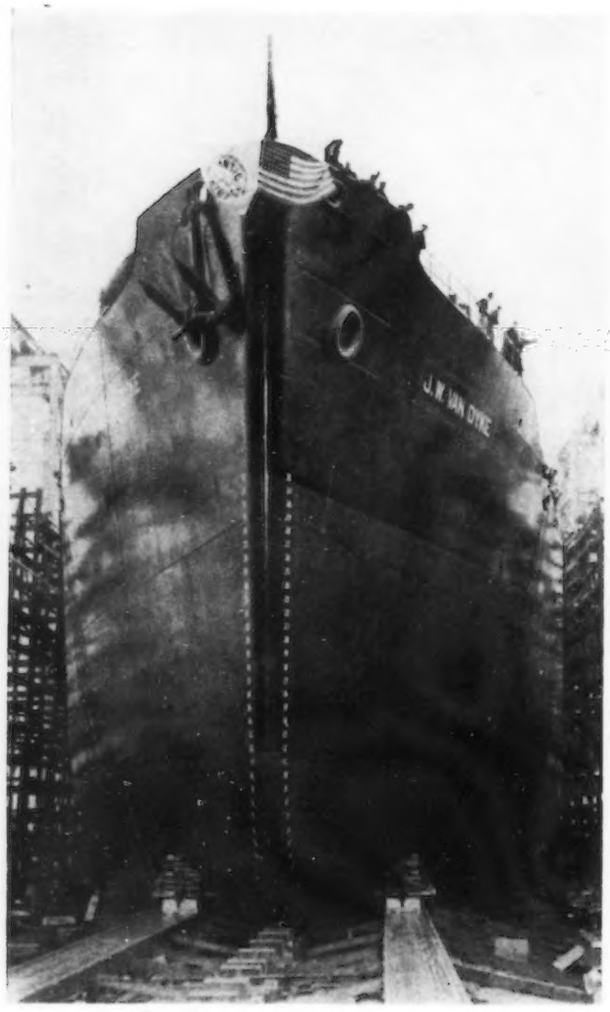
plans are also under way to exploit the Chahar (North China) iron ore mines, and expand output in the Lungyen ore mines (southern Chapei), where deposits equal 100,000 tons (52-60 per cent Fe). Other plans yet in the formative stage, added to those mentioned, will practically double Japan's pig iron and steel output by 1942.

As an indication of how other small countries, normally buyers of finished steel in the world's markets, are striving for home production, consider the case of the South American countries, usually excellent outlets for excess American, German and Japanese production. Chile is building up a scrap reserve with an embargo, and is sponsoring the erection of a steel plant in Corral by Compania Electro-Siderurgica e Industrial de Valdivia. Likewise, Argentina has accumulated 600,000 tons of scrap and is building up this pile at the rate of 75,000 tons per year. The Ministry of War's new steel works at Buenos Aires has just started operation and will take care of the bulk of the country's bar and plate requirements. Additional exploitations of iron and coal reserves throughout South America are currently under advisement.

WORLD PRODUCTION OF STEEL INGOTS AND CASTINGS (Thousands of Gross Tons)

	1913	1929	1930	1931	1932	1933	1934	1935	1936	1937†
United States	31,301	56,433*	40,699	25,945	13,681	23,232	26,055	34,093	47,768	49,800
Germany	18,632	15,989	11,354	8,159	5,678	7,490	11,725	16,184	19,001	19,309*
U.S.S.R.	4,365	4,923	5,769	5,524	5,832	6,733	9,538	12,320	16,077	17,182*
United Kingdom	7,664	9,636	7,326	5,203	5,261	7,024	8,860	9,850	11,785	12,890*
France	4,612	9,544*	9,296	7,697	5,550	6,426	6,075	6,177	6,601	7,680
Japan‡	240	2,206	2,212	1,821	2,315	3,144	3,782	4,628	4,945	5,480*§
Belgium	2,428	4,044*	3,300	3,055	2,745	2,687	2,897	2,975	3,124	3,907
Luxemburg	1,312	2,659*	2,234	2,002	1,925	1,815	1,901	1,808	1,949	2,435
Czechoslovakia	††	2,111	1,807	1,504	640	693	935	1,177	1,534	2,175*
Italy	920	2,088	1,704	1,386	1,374	1,743	1,803	2,174*	1,993	2,100
Saar	**	2,174*	1,904	1,513	1,440	1,649	1,921	**	**	**
Canada	1,042	1,380	1,012	702	335	402	741	915	1,078	1,435*
Poland	1,575*	1,355	1,217	1,020	542	804	831	930	1,123	1,387
Sweden	582	683	601	530	520	620	848	882	961	1,050*
Spain	238	966*	859	594	523	500	639	541	480	365§§
All other countries‡‡	239	2,179	1,806	1,755	1,539	1,798	2,219	3,066	3,301	4,100
Total	75,150	118,370	93,100	68,410	49,900	66,760	80,770	97,720	121,720	131,295*

† December estimated. * Highest yearly production. ** Included in Germany. †† Part of Austria-Hungary. ‡ Includes Korea and Manchuria. ‡‡ India and Australia account for almost half this total. § Japanese statistics suspended by Government on July 1; total shown is an accurate estimate. §§ Data not available; total shown is primarily a blind guess.



Exports

Steel-hungry nations boost demand for American exports to 3,500,000 tons in 1937.

TURBULENT world conditions bringing on elaborate rearmament activities, together with unusual industrial and housing construction in foreign countries, were responsible for the sharp boost in exports of American iron and steel products in 1937. Steel hungry, these countries, geared to top production, did not have sufficient capacity to meet their demands. Assuming 1937 exports reached the estimated total of 3,500,000 gross tons, they made the sixth highest yearly outgoing movement in the history of the trade. It was the largest export movement since 1920. In contrast to the outgoing movement, imports last year were relatively small. They are estimated at 480,000 tons, a drop of 44,000 tons from 1936. Pig iron was the largest incoming product, followed by structural shapes.

Thus to exceed the 1937 export movement, it is necessary to go back to world war years or to two periods immediately following, 1919-20. In the latter years steel producing countries abroad were transforming capacities from war to peace work, and in the midst of opening channels for raw material supplies. They were engaged in huge programs of rehabilitation. They found it necessary to draw heavily on the United States for steel. Provided the estimated 1937 total was reached, it was even larger than that of the war year of 1915, when demands of the Allies on American industry set in strongly and brought the total to 3,450,000 tons. The all-time record was in 1917, the year the United States entered the war. In that year exports of iron and steel products aggregated 6,200,000 tons. As compared with 1936, with an export movement of 1,221,000 tons, foreign shipments of last year saw an increase of about 185 per cent. The active year of 1929, with exports of 2,480,000 tons, was eclipsed last year by 41 per cent.

Japan Principal Buyer

Leading by far as the principal foreign market of American iron and steel products last year was Japan, just as that country also was easily foremost as the buyer of American scrap. Japan in the 10 months ended October, 1937, took 817,339 tons of iron and steel products or 29 per cent of the total. Outstanding products taken by Japan were pig iron, ingots, wire rods, plates and tin plate. In 1936 Japan took only 4 per cent of American iron and steel exports.

Ranking second, Canada took 408,500 tons or 14 per cent of the exports in the first 10 months of 1937, pur-

chasing almost all products in the iron and steel export classification. The principal lines taken were wire, skelp, black steel sheets, shapes, plates and strip steel.

Usually an extremely limited market for American iron and steel, the United Kingdom, its plants unable fully to meet requirements, took 250,000 tons or 9 per cent of American exports in the 1937 10-month period compared with only about 1 per cent imported in 1936. Purchases by the United Kingdom consisted chiefly of pig iron, steel bars, strip steel, and ingots, together with a diversity of other products.

Pig Iron Exports a Record

Establishing an all-time record, pig iron exports in the 1937 10-month period were 719,666 tons, exceeding by 63,446 tons the previous record of 656,220 tons for the entire year of 1917. The leading item of exportation in 1937, foreign shipments of pig iron in the 10-month period were more than twice as great as the second largest movement, made by plates, amounting to 350,529 tons.

Running parallel with the rising demand, the price trend of steel exports rose sharply in 1937 over 1936, but, interestingly the price of pig iron, the product of heaviest exportation, remained almost identical with the 1936 price for the 10 months, rising only 2c. per ton to $24.91. Of the 10 principal steel products exported, the largest price advances were in raw and semi-finished steel — ingots, blooms, etc., which reached an average of $42.66 per ton, an increase of $15 over 1936.

Imports 480,000 Tons

The estimated 1937 import movement of 480,000 tons is 33 per cent below the peak of 720,000 established in 1927, closely followed in 1928 with only 1000 tons less. The lowest import movement during the past decade was in 1934 at 272,000 tons. Imports during other recent years were: 1929—649,000; 1930—510,000; 1931—405,000; 1932—369,000; 1933—358,000.

Belgium was the principal source of imports in the first 10 months of 1937, supplying 122,614 tons, principally shapes, bars and hoops. Germany ranked second with 67,832 tons, mostly of steel pipe, nails and barbed wire. British India supplied 57,950 tons, in which pig iron was the almost sole product. Like exports, import prices in 10 months of 1937 showed a substantial rise, more abrupt than American export price increases, over those of the corresponding period in 1936, the average price per ton for the 12 leading groups increasing to $52.76 from $42.08. The only price decrease was in duty-free barbed wire, which dropped to an average of $51.63 from $56.30. The smallest increase was in pig iron, which rose to an average of $14.72 from $14.24. The largest increase was in wire rods, which rose $19 to $84.50 from $65.50.

EXPORTS OF 10 LEADING PRODUCTS REPRESENTING 81.9 PER CENT OF TOTAL SHIPMENTS

(000 omitted)

	JANUARY-OCTOBER 1937		1936	
	Tons	Per Cent of Total	Tons	Per Cent of Total
Pig Iron	719	25.1	1	0.2
Plate	350	12.3	65	6.9
Tin Plate	270	9.4	190	19.9
Black Steel Sheets	238	8.3	112	11.7
Ingots, etc.	234	8.2	16	1.7
Shapes	148	5.2	65	6.8
Steel Bars	121	4.2	44	4.7
Strip Steel	95	3.3	50	5.3
Rails	93	3.3	61	6.3
Skelp	73	2.6	49	5.1

1937 Scrap Exports

With Far Eastern and European countries in particular anxiously scouring world markets for scrap tonnage, the United States as the largest producer set a peak record of exports of old material in 1937, rushing out 3,520,800 gross tons in the first 10 months, compared with 1,751,000 tons in the corresponding period of last year. So large were American scrap exports that the movement became a subject of sensational publicity in the daily press and magazines which featured the shipments with armament "races" abroad.

OUTSTANDING YEARS OF IRON AND STEEL EXPORTS

(In Gross tons—000 omitted)

1917	6,200
1916	5,885
1918	5,370
1920	4,700
1919	4,360
1915	3,450

Showing concern over both the volume of scrap exports and rapidly rising prices of old material in this country, domestic independent steel companies and foundry interests urged licensing legislation in Congress to limit foreign shipment. Hearings were held on the legislation at the regular session of Congress but no action was taken. With the tapering off in both volume of scrap exports and in prices there is less interest in the legislation, and its passage, always doubtful by reason of State Department opposition, now seems less probable than ever.

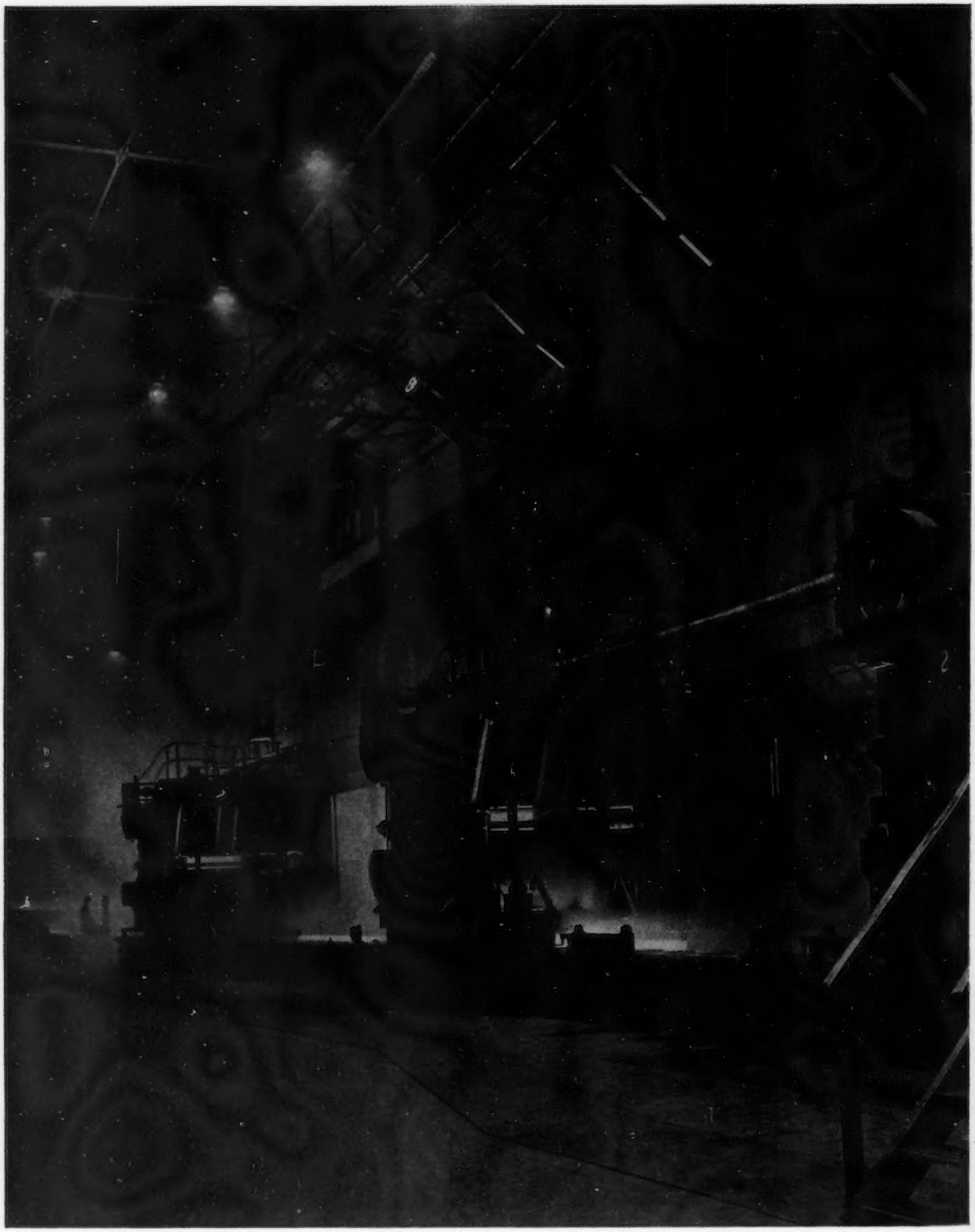
As in former years, Japan was the chief foreign recipient of American scrap exports, taking 1,868,000 tons in the January-October period of 1937, compared with 999,000 in the corresponding period of 1936. Ranking second was the United Kingdom which took 664,000 tons in the first 10 months of last year compared with 358,000 tons in a like period of 1936. Italy took 285,000 and 213,000 tons respectively; Poland 188,000 tons and 165,000 tons and Canada 151,000 and 52,000 tons.

Wide Scrap Fluctuations

The impact on the price structure is disclosed by the fact that the average price per gross ton in the 1937 10-month period rose to $19.77 from $12.42 in the corresponding period of 1936. But with the peak 1937 monthly movement of 638,000 reached in May, along with the highest average price of $21.48, the price trend turned downward, though there were some upward fluctuations. The downward tendency apparently was due to the decline in Japanese purchases, which are said to have been completed about mid-year. Exports began a sharp decline in September when they were 256,000 tons, cut from 478,296 tons in August. They dropped to 185,600 tons in October.

At the start of 1937 foreign shipments of scrap were relatively light, the January movement having been only 72,800 tons. Rapid rises followed until the peak in May was reached. In February exports rose to 151,271 tons, in March to 367,252 tons and in April to 427,886 tons.

The average prices per ton for the first 10 months of last year follow: January, $14.39; February, $17.19; March, $18.59; April, $19.49; May, $21.48; June, $20.17; July, $20.87; August, $19.45; September, $18.80; October, $19.08.



(Photograph, courtesy Bethlehem Steel Co.)

HORSELESS buggies did not need much steel in their make-up. But automobiles do. And the automobile, with its incessant demand for steel sheets, was the chief cause for the development of the continuous mill. Here are the hot-strip roughing stands in one of the newer ones.

STATISTICAL SECTION

of THE IRON AGE

ANNUAL REVIEW NUMBER, JANUARY 6, 1938

Steel Ingot Production in the United States

(THE IRON AGE *figures prior to June, 1917; American Iron and Steel Institute figures since then, with additions for electric and crucible steel*)
(*Thousands of Gross Tons*)

	Jan.	Feb.	March	April	May	June	Half Year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Second Half	Year
1901	1,009	968	1,069	1,085	1,162	1,094	6,388	1,136	1,159	1,079	1,200	1,176	1,018	6,768	13,156
1902	1,223	1,060	1,192	1,256	1,321	1,185	7,237	1,189	1,211	1,209	1,268	1,174	1,268	7,319	14,556
1903	1,217	1,131	1,265	1,322	1,363	1,376	7,674	1,230	1,250	1,277	1,178	822	674	6,431	14,105
1904	759	1,020	1,239	1,325	1,263	1,100	6,706	885	1,001	1,153	1,196	1,262	1,327	6,824	13,530
1905	1,516	1,389	1,710	1,624	1,725	1,576	9,550	1,425	1,629	1,670	1,746	1,770	1,673	9,913	19,463
1906	1,928	1,746	2,018	1,848	1,956	1,833	11,329	1,739	1,794	1,757	2,047	2,029	1,929	11,295	22,624
1907	2,005	1,830	1,949	2,067	2,087	1,944	11,822	1,975	2,046	1,899	2,124	1,654	1,039	10,737	22,559
1908	934	954	1,057	1,023	1,004	972	5,944	1,049	1,171	1,263	1,401	1,350	1,499	7,733	13,677
1909	1,623	1,575	1,722	1,622	1,700	1,801	10,043	1,899	2,030	2,225	2,347	2,376	2,739	13,256	23,299
1910	2,404	2,257	2,506	2,365	2,203	2,157	13,892	1,904	2,016	1,956	1,929	1,818	1,639	11,262	25,154
1911	1,716	1,788	2,199	2,001	1,918	1,801	11,423	1,682	1,951	1,992	2,050	2,015	1,916	11,606	23,029
1912	2,169	2,191	2,441	2,491	2,648	2,461	14,401	2,445	2,648	2,484	2,833	2,759	2,715	15,884	30,285
1913	2,814	2,562	2,679	2,757	2,841	2,532	16,185	2,482	2,466	2,510	2,563	2,151	1,923	14,095	30,280
1914	1,907	1,881	2,287	2,285	2,039	1,930	12,329	1,907	1,944	1,895	1,799	1,470	1,476	10,491	22,820
1915	1,663	1,777	2,226	2,271	2,351	2,555	12,843	2,662	2,887	3,061	3,246	3,259	3,326	18,441	31,284
1916	3,333	3,321	3,527	3,356	3,652	3,473	20,762	3,245	3,481	3,463	3,672	3,581	3,198	20,640	41,402
1917	3,743	3,093	3,864	3,792	4,061	3,617	22,170	3,447	3,663	3,486	3,932	3,714	3,207	21,449	43,619
1918	2,641	2,725	3,728	3,791	3,939	3,696	20,520	3,732	3,696	3,832	4,017	3,568	3,586	22,531	43,051
1919	3,651	3,178	3,128	2,631	2,266	2,607	17,461	2,947	3,226	2,718	2,046	2,513	2,784	16,234	33,695
1920	3,624	3,402	3,917	3,132	3,423	3,539	20,937	3,328	3,562	3,561	3,581	3,133	2,779	19,944	40,881
1921	2,517	1,999	1,795	1,387	1,446	1,146	10,290	918	1,300	1,342	1,847	1,897	1,630	8,934	19,224
1922	1,893	2,071	2,814	2,902	3,219	3,128	16,027	2,953	2,629	2,818	3,410	3,430	3,301	18,541	34,568
1923	3,841	3,472	4,067	3,964	4,216	3,767	23,327	3,531	3,696	3,357	3,577	3,134	2,863	20,159	43,486
1924	3,650	3,326	4,207	3,348	2,640	2,066	19,737	1,878	2,553	2,828	3,125	3,121	3,569	17,074	36,811
1925	4,193	3,752	4,194	3,584	3,455	3,205	22,383	3,084	3,421	3,490	3,889	3,903	3,971	21,758	44,141
1926	4,132	3,785	4,469	4,196	3 928	3,734	24,154	3,635	3,987	3,913	4,074	3,706	3,467	22,782	46,936
1927	3,823	3,845	4,575	4,163	4,083	3,526	24,015	3,232	3,529	3,298	3,345	3,155	3,203	19,762	43,777
1928	4,028	4,081	4,549	4,345	4,246	3,778	25,027	3,841	4,217	4,186	4,693	4,306	4,055	25,298	50,325
1929	4,545	4,372	5,118	4,999	5,339	4,951	29,234	4,898	4,988	4,573	4,579	3,556	2,932	25,526	54,850
1930	3,808	4,067	4,288	4,142	4,014	3,445	23,764	2,945	3,085	2,863	2,714	2,230	1,995	15,831	39,595
1931	2,534	2,570	3,083	2,794	2,574	2,149	15,704	1,907	1,733	1,560	1,655	1,607	1,313	9,725	25,429
1932	1,500	1,496	1,448	1,273	1,137	923	7,777	815	856	1,003	1,099	1,043	871	5,687	13,464
1933	1,030	1,087	910	1,361	2,005	2,599	8,992	3,210	2,905	2,313	2,112	1,540	1,822	13,902	22,894
1934	2,025	2,243	2,836	2,976	3,447	3,102	16,629	1,509	1,399	1,286	1,502	1,633	1,991	9,320	25,949
1935	2,915	2,817	2,910	2,682	2,675	2,294	16,293	2,303	2,962	2,869	3,192	3,200	3,121	17,647	33,940
1936	3,040	2,957	3,334	3,933	4,037	3,975	21,276	3,915	4,184	4,151	4,534	4,323	4,424	25,531	47,512
1937	4,725	4,414	5,216	5,072	5,154	4,184	28,765	4,556	4,875	4,302	3,392	2,154	*2,206	*21,485	*50,250

Figures for 1937 are preliminary. *Estimated.

Pig Iron Production in the United States

(*Thousands of Gross Tons*)
(THE IRON AGE *figures, including ferroalloys made in blast furnaces, but excluding charcoal iron*)

	Jan.	Feb.	March	April	May	June	Half Year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Second Half	Year
1901	1,162	1,134	1,279	1,257	1,339	1,318	7,489	1,360	1,336	1,300	1,382	1,362	1,266	8,006	15,495
1902	1,428	1,258	1,445	1,475	1,543	1,447	8,595	1,442	1,468	1,419	1,481	1,433	1,537	8,780	17,375
1903	1,473	1,391	1,490	1,608	1,714	1,673	9,449	1,546	1,571	1,554	1,426	1,039	847	7,983	17,432
1904	924	1,208	1,451	1,561	1,537	1,296	7,977	1,121	1,173	1,358	1,455	1,487	1,616	8,210	16,187
1905	1,782	1,597	1,936	1,922	1,964	1,793	10,994	1,742	1,844	1,899	2,053	2,014	2,046	11,598	22,592
1906	2,069	1,904	2,165	2,073	2,097	1,977	12,287	2,013	1,927	1,971	2,197	2,188	2,235	12,531	24,818
1907	2,206	2,045	2,226	2,219	2,295	2,235	13,226	2,256	2,250	2,184	2 237	1,828	1,234	12,089	25,315
1908	1,045	1,078	1,228	1,150	1,166	1,092	6,759	1,218	1,360	1,419	1,567	1,578	1,741	8,883	15,642
1909	1,798	1,707	1,836	1,739	1,883	1,931	10,894	2,103	2,249	2,385	2,600	2,547	2,636	14,520	25,414
1910	2,609	2,397	2,618	2,484	2,390	2,265	14,763	2,149	2,107	2,086	2,093	1,910	1,778	12,093	26,856
1911	1,759	1,795	2,171	2,065	1,893	1,788	11,477	1,793	1,927	1,977	2,102	2,000	2,043	11,842	23,313
1912	2,058	2,101	2,405	2,375	2,513	2,441	13,893	2,411	2,512	2,464	2,690	2,631	2,782	15,490	29,383
1913	2,795	2,586	2,764	2,753	2,822	2,629	16,349	2,561	2,546	2,506	2,546	2,233	1,984	14,376	30,725
1914	1,885	1,888	2,348	2,270	2,093	1,918	12,402	1,958	1,995	1,883	1,778	1,518	1,516	10,648	23,050
1915	1,601	1,685	2,064	2,117	2,263	2,381	12,101	2,563	2,780	2,853	3,126	3,037	3,203	17,562	29,663
1916	3,185	3,087	3,339	3,227	3,361	3,211	19,410	3,224	3,204	3,202	3,509	3,312	3,178	19,629	39,040
1917	3,151	2,645	3,252	3,335	3,417	3,270	19,070	3,342	3,248	3,134	3,303	3,206	2,883	19 116	38,186
1918	2,412	2,319	3,213	3,288	3,447	3,324	18,003	3,421	3,389	3,418	3,487	3,354	3,434	20,503	38,506
1919	3,303	2,940	3,090	2,478	2,108	2,115	16,034	2,429	2,743	2,488	1,864	2,392	2,633	14,549	30,583
1920	3,015	2,979	3,376	2,739	2,986	3,044	18,139	3,067	3,147	3,129	3,293	2,935	2,704	18,275	36,414
1921	2,416	1,937	1,596	1,193	1,221	1,065	9,428	865	954	986	1,247	1,415	1,649	7,116	16,544
1922	1,645	1,630	2,036	2,072	2,306	2,361	12,050	2,405	1,816	2,034	2,639	2,849	3,087	14,830	26,880
1923	3,229	2,994	3,524	3,550	3,868	3,676	20,841	3,678	3,450	3,126	3.149	2,894	2,921	19,218	40,059
1924	3,019	3,075	3,466	3,233	2,615	2,026	17,434	1,785	1,887	2,053	2,477	2.510	2,962	13.674	31,108
1925	3,370	3,214	3,564	3,259	2,931	2,674	19,012	2,664	2,705	2,726	3,023	3,023	3,250	17,391	36,403
1926	3,316	2,923	3,442	3,450	3,482	3,235	19,848	3,223	3,201	3,136	3,334	3 237	3,091	19,222	39,070
1927	3,104	2,941	3,483	3,422	3,391	3,090	19,431	2,951	2,947	2,775	2,784	2,648	2,696	16,801	36,232
1928	2,870	2,900	3,200	3,185	3,284	3,082	18,521	3,072	3,137	3,062	3,374	3,302	3,370	19,317	37,838
1929	3,442	3,206	3,714	3,663	3,898	3,717	21,621	3,785	3,756	3,498	3,588	3,181	2,837	20,665	42,286
1930	2,827	2,839	3,246	3,182	3,233	2,934	18,261	2,639	2,524	2,277	2,165	1.867	1,666	13,139	31,399
1931	1,714	1,707	2,032	2,020	1,994	1,639	11,105	1,463	1,281	1,169	1,173	1,103	980	7,170	18,275
1932	972	964	967	852	783	628	5,168	572	520	592	644	631	546	3,518	8,686
1933	569	554	542	624	887	1,265	4,441	1,792	1,833	1,522	1,356	1,085	1,182	8,902	13,213
1934	1,215	1,264	1,620	1,727	2,043	1,930	9,798	1,225	1,054	898	951	957	1,028	6,113	15,911
1935	1,477	1,609	1,770	1,663	1,727	1,553	9,799	1,520	1,761	1,777	1,978	2,066	2,106	11,209	21,008
1936	2,026	1,824	2,040	2,404	2,648	2,586	13,528	2,594	2,712	2,730	2,992	2,947	3,115	17,090	30,618
1937	3,212	2,997	3,459	3,392	3,537	3,108	19,707	3,499	3,606	3,410	2,892	2,096	*1,750	*17,163	*36,870

*Estimated.

Weekly Production of Steel Ingots in the United States

(Thousands of Gross Tons)
(From American Iron and Steel Institute)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec	Average for Year
1926	933	946	1,009	957	887	870	822	900	914	920	864	784	900
1927	855	953	1,024	962	914	815	725	790	764	748	729	718	832
1928	901	977	1,017	1,004	950	873	861	943	969	1,050	995	909	954
1929	1,016	1,062	1,144	1,154	1,193	1,143	1,097	1,115	1,058	1,024	821	657	1,042
1930	853	1,009	960	958	899	797	661	691	664	608	516	448	753
1931	567	637	689	645	576	496	427	388	361	359	371	294	483
1932	335	358	324	294	254	213	183	191	232	245	241	195	255
1933	230	268	203	314	446	598	717	646	533	471	355	407	433
1934	451	553	632	684	767	713	337	312	296	335	375	444	491
1935	648	694	647	616	595	526	513	658	660	709	734	695	641
1936	686	714	753	915	911	927	886	945	970	1,024	1,008	1,001	895
1937	1,067	1,103	1,177	1,182	1,163	975	1,031	1,101	1,005	766	502	.....	.....

Monthly Production of Steel Ingots in the United States

Per Cent of Capacity
(From American Iron and Steel Institute)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average for Year
1926	87.09	88.35	94.18	89.36	82.79	81.27	76.78	84.03	85.37	85.88	80.65	73.23	84.05
1927	77.94	86.82	93.27	87.65	83.23	74.24	66.04	71.95	69.58	68.20	66.41	65.45	75.83
1928	80.33	87.09	90.73	89.49	84.69	77.82	76.78	84.11	86.42	93.60	88.69	81.07	85.05
1929	86.84	92.51	97.80	98.64	102.01	97.70	93.82	95.31	90.44	87.50	70.17	56.15	89.05
1930	71.42	84.47	80.42	80.21	75.29	66.73	55.36	57.86	55.57	50.90	43.18	37.50	63.09
1931	44.75	50.25	54.41	50.90	45.46	39.14	33.70	30.58	28.50	28.33	29.28	23.23	38.13
1932	25.97	27.72	25.07	22.75	19.68	16.49	14.14	14.81	17.96	19.01	18.64	15.09	19.75
1933	17.76	20.76	15.69	24.27	34.52	46.25	55.46	50.02	41.27	36.42	27.44	31.49	33.53
1934	34.33	42.10	48.10	52.11	58.43	54.30	25.66	23.74	22.57	25.47	28.59	33.84	37.38
1935	49.06	52.52	48.98	46.61	45.02	39.87	38.86	49.85	49.99	53.72	55.61	52.66	48.54
1936	52.39	54.53	57.40	69.99	69.58	70.75	67.61	72.11	74.05	78.15	76.94	76.42	68.36
1937	81.43	84.25	89.91	90.27	88.82	74.46	78.49	83.79	76.52	58.31	38.22	.....	.....

Monthly Shipments of Steel Products by United States Steel Corp., Net Tons

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	*Total
1931	800,031	762,522	907,251	878,558	764,178	653,104	593,900	573,372	486,928	476,032	435,697	351,211	7,676,744
1932	426,271	413,001	388,579	395,091	338,202	324,746	272,448	291,688	316,019	310,007	275,594	227,576	3,974,062
1933	285,138	275,929	256,793	335,321	455,302	603,937	701,322	668,155	575,161	572,897	430,358	600,639	5,805,235
1934	331,777	385,500	588,209	643,009	745,063	985,337	369,938	378,023	370,306	343,962	366,119	418,630	5,925,873
1935	534,055	583,137	668,056	591,728	598,915	578,108	547,794	624,497	514,933	686,741	681,820	661,515	7,371,299
1936	721,414	676,315	783,552	979,907	984,097	886,065	950,851	923,703	961,803	1,007,417	882,643	1,067,365	10,784,273
1937	1,149,918	1,133,724	1,414,399	1,343,644	1,304,039	1,268,550	1,186,752	1,107,858	1,047,962	792,310	587,241	.....	.....

*Less yearly adjustment.

Bookings of Fabricated Steel Plate in the United States, Net Tons

(From United States Department of Commerce)

	Jan.	Feb.	March	April	May	June	Half Year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Second Half	Year
1924	25,563	19,803	25,341	23,688	29,429	34,125	157,949	26,268	36,287	23,270	28,566	36,881	52,606	203,878	361,827
1925	30,013	24,167	26,777	27,656	32,889	38,496	179,998	34,382	40,660	31,001	34,766	32,847	35,792	209,448	389,446
1926	29,965	39,889	43,089	39,662	52,890	44,938	250,439	37,300	51,342	38,860	45,139	63,271	30,034	265,939	516,378
1927	36,043	59,843	55,675	47,611	38,063	28,936	266,171	35,609	48,780	38,863	47,296	27,524	35,877	233,949	500,120
1928	51,647	64,909	55,016	55,552	49,313	40,738	317,175	41,629	51,008	43,499	59,836	62,914	52,204	311,090	628,265
1929	40,570	70,314	69,344	54,246	58,293	57,975	350,739	58,456	51,590	51,842	45,661	52,642	27,742	287,936	638,675
1930	57,083	34,662	46,137	45,454	38,328	41,774	263,439	38,283	36,513	41,066	30,197	33,151	26,787	205,996	469,435
1931	27,518	24,438	31,056	29,916	26,210	22,806	161,944	27,261	24,282	33,473	20,839	18,268	16,442	140,565	302,509
1932	17,613	17,755	12,564	14,074	17,888	18,383	98,277	12,485	11,916	11,109	16,737	7,873	9,510	69,630	167,907
1933	11,128	16,588	8,903	9,502	16,243	37,020	99,384	20,058	16,320	16,166	17,964	14,466	13,692	98,666	198,050
1934	15,897	14,641	38,924	20,085	21,891	27,395	138,833	12,523	16,293	15,108	16,581	16,629	26,025	103,159	241,992
1935	18,778	15,064	16,832	13,244	17,630	17,914	99,462	18,890	23,628	31,105	30,530	19,116	35,584	158,853	258,315
1936	38,709	27,863	30,437	30,018	51,443	52,937	231,407	60,324	31,999	35,033	33,791	40,465	51,017	252,629	484,036
1937	41,419	32,375	71,250	42,455	28,913	34,833	251,245	27,480	31,763	31,484	31,942	27,507	.....	.....	.....

Fabricated Structural Steel Orders in the United States, Net Tons

(From United States Department of Commerce Through 1932; 1933-36 Figures Computed by American Institute of Steel Construction, Inc.)

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1911	114,800	94,300	135,300	114,800	129,150	159,900	141,450	156,050	153,750	106,600	180,400	178,350	1,674,850
1912	154,070	169,260	147,560	128,030	219,170	160,580	154,070	175,770	141,050	199,640	138,880	145,390	1,933,470
1913	130,500	162,000	110,250	90,000	119,250	96,750	130,500	96,750	65,250	78,750	60,750	60,750	1,201,500
1914	140,740	143,010	172,520	199,760	129,390	127,120	154,360	63,560	86,260	79,450	45,400	79,450	1,421,020
1915	57,750	69,300	147,840	143,220	140,910	184,800	198,660	196,350	154,770	180,180	242,550	279,510	1,995,840
1916	164,220	178,500	242,760	173,740	190,400	138,040	114,240	152,320	126,140	183,260	185,640	204,680	2,053,940
1917	147,620	142 780	164,560	147,620	135,520	113,740	101,640	91,960	70,180	147,620	186,340	275,880	1,725,460
1918	136,740	144,480	121,260	165,120	154,800	144,480	299,280	147,060	154,800	110,940	69,660	74,820	1,723 440
1919	31,920	34,580	47,880	66,500	130,340	172,900	196,840	207,480	207,480	207,480	183,540	226,100	1,713,040
1920	207,000	262,200	231,840	187,680	171,120	138,000	138,000	110,400	118,680	71,760	74,520	71,760	1,782,960
1921	50,940	39,620	82,070	87,730	79,240	104,710	96,220	93,390	135,840	152,820	155,650	113,200	1,191,430
1922	121,600	133,760	234,080	258,400	240,160	221,920	206,720	206,720	194,560	176,320	152,000	185,440	2,331,680
1923	227,760	243,360	290,160	243,360	177,840	165,360	162,240	184,080	165,360	159,120	171,600	249,600	2,439,840
1924	224,940	228,200	221,680	208,640	192,340	208,640	224,940	195,600	211,900	211,900	270,580	247,760	2,647,120
1925	187,350	194,320	225,550	256,780	229,020	284,540	274,130	267,190	270,660	298,420	239,430	253,310	2,980,730
1926	208,800	208,800	234,000	252,000	266,400	262,800	248,400	284,400	216,000	223,200	223,200	259,200	2,894,400
1927	195,000	240,000	232,500	262,500	232,500	225,000	341,250	270,000	262,500	288,750	236,250	262,500	3,048,750
1928	207,900	265,650	257,950	234,850	308,000	296,450	296,450	354,200	319,550	257,950	242,550	246,400	3,287,900
1929	256,025	250,635	334,565	313,775	321,475	324,170	329,175	340,725	297,990	319,550	212,135	297,605	3,597,825
1930	238,800	267,600	236,800	222,800	297,200	253,600	270,000	252,000	155,600	209,200	151,200	152,800	2,707,600
1931	158,000	158,800	178,800	284,800	152,400	172,400	159,600	124,000	194,400	109,200	90,800	97,600	1,880,800
1932	48,400	62,000	64,400	64,800	99,800	86,800	67,200	78,800	111,200	74,400	51,600	143,600	955,000
1933	93,200	63,700	87,900	56,200	52,100	101,300	67,700	95,600	72,500	63,700	65,000	103,900	922,800
1934	91,594	75 294	105,537	121,552	78,608	122,706	73,723	94,186	62,657	65,037	85,250	68,449	1,044,593
1935	64,306	75,841	102,325	95,380	60,448	120,690	65,957	102,859	90,161	102,708	91,693	96,235	1,068,603
1936	120,364	140,943	108,826	112,195	147,261	132,387	199,057	110,687	118,158	130,989	121,607	166,542	1,609,016
1937	153,806	101,710	206,321	158,471	122,939	175,552	160,970	117,612	117,859	46,912	136,542	.....	.....

Steel Castings Orders in the United States, Net Tons

(From United States Department of Commerce)

	Jan	Feb	March	April	May	June	Half Year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Second Half	Year
1921	34,401	33,906	29,260	24,512	23,311	23,739	169,129	20,177	23,327	27,822	38,105	47,286	37,200	193,917	363,046
1922	43,230	46,520	60,080	94,920	97,350	112,120	454,220	83,010	79,560	122,840	94,980	76,400	86,420	543,210	997,430
1923	126,481	112,399	172,101	118,196	117,834	109,756	756,767	73,600	76,208	71,506	64,677	63,870	61,016	410,877	1,167,644
1924	69,872	91,502	126,986	93,518	79,988	68,019	529,885	54,538	50,321	76,005	83,221	91,388	115,605	471,078	1,000,963
1925	104,179	81,930	83,812	87,556	78,417	66,437	502,331	72,294	71,160	62,198	86,510	86,957	105,893	479,012	981,343
1926	112,322	101,495	113,770	91,540	84,451	73,785	577,363	79,798	71,325	69,740	77,836	73,477	90,143	462,319	1,039,682
1927	108,063	94,938	90,353	81,403	73,043	91,199	539,001	74,569	63,938	52,742	52,160	63,075	77,436	383,920	922,921
1928	91,448	91,076	83,755	84,086	86,796	72,107	509,268	66,992	81,286	82,762	78,860	84,742	96,318	490,960	1,000,228
1929	124,313	115,639	130,836	144,366	113,092	94,873	723,119	103,046	101,514	86,241	35,879	97,635	89,985	614,300	1,337,419
1930	101,500	114,419	122,462	92,987	91,077	61,164	583,609	57,850	50,370	49,542	45,552	48,123	49,387	300,824	884,433
1931	46,810	40,320	48,184	46,039	39,052	26,136	246,541	32,869	27,458	23,073	22,854	20,001	20,799	147,054	393,595
1932	17,214	16,759	16,323	12,459	11,111	12,488	86,354	9,301	10,147	11,882	11,896	13,235	13,022	69,483	155,837
1933	14,450	13,179	13,178	15,942	22,612	34,965	114,326	31,878	31,502	25,220	26,135	25,558	25,612	165,905	280,231
1934	26,296	35,698	60,046	63,142	46,831	41,537	273,550	41,822	25,538	20,030	24,327	21,552	27,312	160,581	434,131
1935	32,349	31,725	30,723	28,233	29,083	30,257	182,370	34,570	45,426	29,995	34,553	32,714	40,529	217,787	400,157
1936	59,019	51,701	71,341	83,188	63,950	94,345	423,544	74,011	59,393	56,877	59,431	76,394	159,430	485,536	909,080
1937	114,959	95,693	158,079	99,672	68,688	71,817	608,908	57,799	54,753	57,414	36,837	.....	.....	.....	.....

Figures for 1935-37 from 180 manufacturers, for 1933-34 from 164 manufacturers; prior to 1933, 128 producers reported.

Malleable Castings Produced in the United States, Net Tons

(From United States Department of Commerce)

	Jan.	Feb.	March	April	May	June	Half Year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Second Half	Year
1925	71,188	64,825	65,889	67,608	65,714	63,343	398,567	61,727	61,042	62,798	73,195	65,248	70,622	394,632	793,199
1926	66,776	71,161	80,116	72,241	65,106	66,358	421,758	60,384	62,218	63,399	62,321	50,946	55,561	354,829	776,587
1927	56,627	62,335	72,205	64,612	62,747	64,310	382,836	53,046	57,096	50,807	52,458	46,698	53,824	313,929	696,765
1928	61,072	65,359	70,970	63,380	67,903	67,090	394,874	60,290	68,606	62,665	70,054	63,560	59,428	384,603	779,477
1929	73,125	73,875	83,365	83,744	81,641	72,232	467,982	70,600	69,173	59,087	65,526	46,459	46,029	356,874	824,856
1930	61,381	65,942	63,464	61,984	53,502	39,347	345,620	30,911	25,614	26,785	28,785	27,114	30,431	169,383	515,003
1931	31,665	34,076	35,758	36,682	31,964	24,248	194,393	20,223	18,821	18,485	20,444	17,984	21,503	117,460	311,853
1932	20,399	19,834	17,844	15,461	16,597	15,018	105,153	9,447	6,804	10,051	12,274	13,622	14,128	66,326	171,479
1933	12,638	13,780	9,959	18,566	24,628	31,118	110,689	30,865	31,811	27,078	24,381	21,944	21,870	157,949	268,838
1934	30,417	33,939	43,438	40,742	37,165	28,340	214,041	23,388	23,910	21,541	25,317	28,515	32,746	155,417	369,458
1935	43 400	41,377	42,808	42,035	34,729	27,548	231,897	28,915	35,245	36,996	43,467	44,317	45,598	234,498	466,395
1936	48,198	40,611	45,536	50,954	45,027	43,766	274,092	44,413	42,253	46,552	51,778	50,934	61,674	297,604	571,696
1937	53,638	57,295	67,559	63,377	55,960	54,026	351,855	45,479	49,022	52,728	42,953	.....	.....	.....	.....

Annual Shipments of Lake Superior Iron Ore by Water, Gross Tons

(Reported by Lake Superior Iron Ore Association)

	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Shipments	58,537,855	51,107,136	53,980,874	65,204,600	46,582,982	23,467,786	3,567,985	21,623,898	22,249,600	28,362,368	44,822,023	62,598,836

Monthly Average Pig Iron Prices Computed From

Composite Pig

Average of THE IRON AGE quotations on basic pig iron at Buffalo, Valley and Philadel

	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919
Jan	$15 82	$22 06	$13.47	$15.95	$17.30	$23 24	$16 84	$15 68	$17.12	$13.63	$12 65	$16 49	$12 76	$12.38	$17 81	$28 88	$33.21	$31 36
Feb	16 14	21.47	13.17	15 84	17.10	23.33	16 30	15 35	16.77	13.83	12 61	16 31	13.18	12.38	17 76	29.75	33 21	31.36
March	16.93	21.54	13.43	15.98	17 10	23.02	15.97	15 03	16.29	13.88	12 93	16.07	13 16	12.34	18.06	32 18	33.21	30 10
April	18.27	20 93	13.65	15.68	17.03	23.03	15 55	14.38	15.97	13.79	13.09	15 74	13.13	12.37	18.15	38 56	32.71	27.11
May	19.96	19 54	13 10	15.63	17.07	23.97	15.16	14.38	15.27	13.53	13.27	14.98	13.06	12.37	18.08	41.87	32.71	26.91
June	20.91	18.83	12 66	15.04	16.94	23.47	15.35	14.71	14.90	13.27	13 36	14.35	12.97	12.45	17.91	47 95	32.71	26 46
July	21.25	17 79	11 84	14.37	16 96	22.51	14.91	15 18	14 72	13.21	13.68	13 99	12.92	12.55	17 79	52 11	32.73	26.37
Aug	21.70	16 98	12 07	14.64	17 68	21.82	15 05	15 52	14 39	13.12	14 15	13 93	12.91	13 55	17 63	51 43	32 73	26.83
Sept	22 27	16.03	12.07	14.94	18.59	20.55	15 03	16 41	14.17	12.99	14 74	13.97	12.83	14.28	17 82	46 93	32.73	27 11
Oct	22.35	15 02	12.67	15.61	19.52	19.88	14.79	17.25	13 79	12.84	16.01	13 93	12.67	14.67	19.18	33 21	34.31	27.52
Nov	22.54	14 23	14 37	17.01	22.17	18.66	15 21	17 46	13 74	12 71	16 52	13.39	12 42	15.82	24.36	33.21	34 36	30.34
Dec	22 33	13.75	15.77	17.10	22.82	17.52	15 73	17.26	13.78	12.59	16.63	13.06	12.39	17.34	28.63	33.21	34.26	36.13
Aver	*20.04*	*18.18*	*13.20*	*15.65*	*18.36*	*21.75*	*15.49*	*15.72*	*15.08*	*13.28*	*14 14*	*14.68*	*12.87*	*13.54*	*19 43*	*39.11*	*33. 24*	*28.96*

Basic Pig Iron at Mahoning or Shenango Valley Furnace, Gross Ton

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	$30 00	$18.15	$25 80	$21 25	$22.00	$20 00	$18 00	$17.00	$17 50	$18.50	$17.00	$15 00	$13 50	$17 00	$18 00	$19.00	$20 50
Feb	27 50	17.75	26 25	22 00	22.00	20.00	18 00	17.00	17 50	18.50	16.75	14.62	13 50	17 00	18 00	19.00	20 75
March	24.20	17.94	30 13	21 94	21 30	20 00	18.40	17.00	17 50	18.50	16 50	14.50	13.50	17 00	18 00	19.00	23.10
April	22 88	20 00	31 05	21 55	20.13	18.63	19 00	16.88	17.90	18 50	16.50	14.50	13.50	17.25	18 00	19.00	23.50
May	22 00	24.60	29.00	20 50	18 81	18.38	18.20	16.30	18 38	18 50	16.25	14 20	14 20	18.00	18 00	19.00	23.50
June	20 75	25 00	27 38	19 63	18.05	18.00	17 88	15.45	18.50	18.50	15.50	14.00	15.00	18.00	18.00	19.00	23.50
July	19 38	24 25	25 10	19 00	18 00	17.63	17 50	16.00	18 50	18 10	15 50	13 50	15 50	18.00	18 00	19.00	23 50
Aug	18.20	26 60	24 75	19 00	18.00	17.50	17 30	16.00	18 50	18 00	15.50	13 50	16 20	18 00	18 00	19.00	23.50
Sept	19 13	32.63	24 88	19.00	18 30	17 50	17 06	16 19	18.50	17.60	15.50	13.50	17 00	18 00	18.00	19 00	23.50
Oct	19 19	30 90	23.50	19 00	18.63	18 00	17 00	17 10	18.50	17.00	15.25	13 50	17 00	18.00	18.00	19.00	23.50
Nov	19.00	27 75	20.88	19 13	19 88	18.50	17 00	17.50	18.50	17 00	15.00	13.50	17.00	18.00	19.00	19.25	23.50
Dec	18.63	24.81	21.00	20.90	20.00	18 50	17 00	17.50	18.50	17.00	15.00	13.50	17.00	18.00	19.00	20.00	23.50
Aver	*21.74*	*24.20*	*25.81*	*20.24*	*19.59*	*18.55*	*17.70*	*16.66*	*18.19*	*17.98*	*15.85*	*13.98*	*15.24*	*17.69*	*18.17*	*19.10*	*22.99*

No. 2 Foundry Iron at Mahoning or Shenango Valley Furnace, Gross Ton

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	$31.88	$19.30	$27.00	$22 50	$22.38	$20 50	$18.50	$17.25	$17.50	$18.50	$17.00	$15 50	$14 50	$17.50	$18.50	$19.50	$21.00
Feb	28.00	18.88	27.50	23.00	22.00	20 50	18.50	17 25	17 50	18 50	16 75	15 12	14.50	17.50	18.50	19.50	21 25
March	25 90	19.00	30.50	23.00	21.10	20.50	18.50	17.25	17.75	18.50	16.50	15 00	14.50	17.50	18.50	19.50	23.60
April	24.75	20.75	31.00	21.80	20.13	19.00	18 50	17.25	18 00	18 50	17 00	15 00	14.50	17.75	18.50	19.50	24 00
May	23.50	23.80	30.20	20.75	19.13	18 88	18 50	17.20	18.50	18.50	17.00	14.70	14.70	18.50	18 50	19.50	24.00
June	22.10	24.00	27.63	19.63	18.30	17.96	18.13	16.75	18.50	18.50	17.00	14.50	15.50	18.50	18.50	19.50	24.00
July	20.13	24.25	25.50	19.00	18.50	17.69	18.00	16.65	18.50	18.10	17 00	14.50	16 00	18.50	18 50	19.50	24 00
Aug	19.63	32.60	24.88	19.13	18.50	17 50	17 60	16.50	18.50	18.00	17 00	14.50	16.70	18.50	18.50	19.50	24.00
Sept	21.00	34.88	24.75	19.80	18.80	17.63	17 50	16.88	18.50	17.80	17 00	14.50	17 50	18.50	18 50	19.50	24.00
Oct	21 00	31.80	23.60	19.50	19.13	18.50	17.50	17 10	18 50	17.13	16.63	14.50	17.50	18.50	18.50	19.50	24.00
Nov	20.75	27.88	21.88	19.50	20.39	19.00	17.45	17.63	18.50	17.00	16.00	14.50	17.50	18.50	19.50	19.75	24.00
Dec	20.00	25.63	22.00	21.20	20.50	18.80	17.25	17.70	18.50	17.00	15.70	14.50	17.50	18 50	19.50	20.50	24.00
Aver	*23.22*	*25.23*	*26.37*	*20.73*	*19.90*	*18.87*	*18.00*	*17.12*	*18.23*	*18.00*	*16.72*	*14.73*	*15.91*	*18.19*	*18.67*	*19.60*	*23.49*

Malleable Pig Iron at Mahoning or Shenango Valley Furnace, Gross Ton

	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	$27.00	$22.39	$22.39	$20.50	$18.50	$17.30	$18.00	$19.00	$17.50	$16.00	$14.50	$17.50	$18.50	$19.50	$21.00
Feb	27.63	23.00	22.00	20.50	18.50	17.25	18.00	19.00	17.25	15.62	14.50	17.50	18.50	19.50	21.25
March	30.50	22.50	21.50	20.50	18 50	17.25	18.25	19.00	17.00	15.50	14.50	17.50	18.50	19.50	23.60
April	31.00	22.10	20.63	19 00	18.50	17.25	18.50	19.00	17.00	15.50	14.50	17.75	18.50	19.50	24.00
May	30.20	21.00	19.25	18.88	18 50	17.25	19.00	19.00	17.00	15.20	14.70	18 50	18.50	19.50	24.00
June	28.13	19.88	18.50	18.05	18.13	17.00	19.00	19.00	17.00	15.00	15.50	18.50	18.50	19.50	24.00
July	25.40	19.00	18.50	17.75	18.00	17.00	19.00	18.60	17.00	14 50	16.00	18.50	18.50	19.50	24.00
Aug	24.50	19.13	18.50	17.50	17.60	17.00	19.00	18.50	17.00	14.50	16.70	18.50	18.50	19.50	24.00
Sept	24.50	19.80	18.80	17.63	17.50	17.19	19.00	18.30	17.00	14.50	17.50	18.50	18.50	19.50	24.00
Oct	23.30	19.50	19.13	18.50	17.50	17.55	19.00	17.75	16.88	14.50	17.50	18.50	18.50	19.50	24.00
Nov	20.88	19.75	20.38	19.00	17.50	18.19	19.00	17.50	16.50	14.50	17.50	18.50	19.50	19.75	24.00
Dec	20.00	21.20	20.50	18.75	17.50	18.15	19.00	17.50	16.20	14.50	17 50	18.50	19.50	20.50	24.00
Aver	*26.09*	*20.77*	*20.01*	*18.88*	*18.02*	*17.37*	*18.73*	*18.51*	*16.94*	*14.98*	*15.91*	*18.19*	*18.67*	*19 60*	*23.49*

No. 2 Foundry Pig Iron at St. Louis and at Granite City,* Ill., Furnace, Gross Ton

	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	$25.06	$24.56	$22.31	$20.56	$20.75	$20.50	$18.25	$18.33	$18.33	$17.50	$18.50	$19.50	$21.00
Feb	26 06	24.56	22.06	20.56	20.75	20.50	18.25	18.33	18.33	17.50	18.50	19.50	21.25
March	26.06	24.56	21.86	20.56	20.75	20.44	18.25	18.33	18.33	17.50	18.50	19.50	23.60
April	24.37	24.00	21.56	20.56	20.75	20.25	18.25	18.33	17.34	17.75	18.50	19.50	24.00
May	22.50	23.56	21.56	19.81	20.75	19.75	18.25	18.33	16.55	18.50	18.50	19.50	24.00
June	21.56	23.16	21.31	19.81	20.75	19.75	18.25	18.33	16.85	18.50	18.50	19.50	24.00
July	21.56	23.06	21.06	19.76	20.75	19.10	18.25	18.33	17.35	18.50	18.50	19.50	24.00
Aug	21.81	23.06	20.56	19.68	20.69	19.00	18.25	18.33	17.85	18.50	18.50	19.50	24.00
Sept	22.96	23.06	20.56	20.31	20.50	18.70	18.25	18.33	*17.50	18.50	18.50	19.50	24.00
Oct	23.62	22.56	20.56	20.56	20.50	18.25	18.25	18.33	17.50	18.50	18.70	19.50	24.00
Nov	24.12	22.36	20.56	20.87	20.50	18.25	18.25	18.33	17.50	18.50	19.50	19.75	24.00
Dec	24.56	22.56	20.56	20.81	20.50	18.25	18.25	18.33	17.50	18.50	19.50	20.50	24.00
Aver	*23.69*	*23.42*	*21.21*	*20.33*	*20.66*	*19.39*	*18.25*	*18.33*	*17.58*	*18.19*	*18.68*	*19.60*	*23.49*

*Since Sept. 1, 1933, Granite City furnace prices are quoted.

Weekly Market Quotations In THE IRON AGE

Iron Price

Valley furnace and foundry iron at Chicago, Birmingham, phia. Quoted in gross tons

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	$39.39	$31.18	$18.48	$26.78	$22.15	$22 44	$21.79	$19.44	$17 63	$18 43	$18 19	$15.90	$14 68	$13 56	$16.90	$17 90	$18.84	$20 25
Feb	42 35	28.45	18.14	27 20	22.84	22 50	21.77	19.07	17 73	18 38	18 02	15.80	14 51	13 56	16 90	17.90	18 84	20.50
March	42.24	25.18	18.35	30 11	22.81	21 99	21 65	19 03	17 73	18 36	17 75	15 71	14 45	13 56	16 90	17 90	18.84	22.85
April	43.01	23.73	20.00	30.83	22 31	20.95	20.96	19 21	17 67	18.52	17 73	15 79	14 35	13 76	17 07	17 90	18.84	23.25
May	43.64	22 78	23 35	29.74	21 40	19 85	20 69	19 09	17 45	18 70	17 60	15 76	14 12	14 48	17 90	17 85	18 84	23.25
June	44.09	21 73	23 95	28 23	20 27	19.22	20 00	18.92	17 23	18 65	17 48	15.62	14 01	15 01	17 90	17 84	18 84	23.25
July	45 44	20 22	23 86	25 96	19.31	18 96	19 51	18.56	17 10	18 48	17 16	15 56	13 76	15 50	17 90	17.84	18.84	23.25
Aug	47 38	18 97	26.69	25 19	19 40	19 01	19 46	18 17	17 11	18 39	16.90	15.51	13 69	16 09	17 90	17 84	18 73	23.25
Sept	47.83	19 89	31.78	25.02	19 46	19.39	19 46	18.03	17.54	18.27	16 70	15 44	13 64	16 71	17 90	17 84	18 73	23.25
Oct	45.05	19.97	30.57	23.30	19.46	19.92	19.69	17.96	17.94	18.33	16.31	15 21	13 63	16 61	17 90	17 87	18 73	23.25
Nov	38.65	19.79	27 82	21.40	19.79	21.16	20.13	17 59	18.46	18 36	16.21	14 97	13 59	16 61	17 90	18 84	18 98	23.25
Dec	34.51	19.11	25.70	21 88	21.60	21.54	19.94	17.55	18.51	18.24	15.95	14 86	13 56	16.90	17 90	18 84	19.73	23.25
Aver	*42.76*	*22 58*	*24.06*	*26.30*	*20.90*	*20.58*	*20.42*	*18.55*	*17.68*	*18.43*	*17.17*	*15.51*	*14 00*	*15 20*	*17.58*	*18.05*	*18.90*	*22.74*

Eastern Pennsylvania No. 2X Foundry Pig Iron at Philadelphia, Gross Ton

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	$33.34	$21 34	$29 76	$24.11	$25 01	$24 26	$22.76	$50.56	$21.76	$21.26	$18.26	$16 14	$13.84	$19.51	$20.51	$21.56	$23.01
Feb	31.09	21 09	30 01	24.04	25 01	24 14	22 26	21 14	21.76	21 26	18.26	16 14	13.34	19 51	20 51	21 56	23.26
March	27 59	21.26	32 30	24.16	24 21	23.36	22 26	21 26	21.89	20 76	18.26	16 12	13 84	19 51	20 51	21 56	25.61
April	26.26	23.62	32 95	23.06	22 82	23.26	22.26	21.26	22.26	20 76	18.26	16 0[illegible]	14.59	19.76	20 51	21 56	26.01
May	25.71	26.09	32.76	22.67	21 51	22.89	22 26	21.26	22.26	20 39	17 76	15 34	15 99	20 51	20 55	21.56	26.01
June	25 50	27.06	30.76	21.85	21 26	22 66	22 14	21.26	22 26	20 26	17.71	15 34	16.84	20.51	20 56	21.56	26 01
July	23 55	27 92	27 68	21.26	21.26	22.26	21 51	20.86	22 16	19 96	17.51	14 84	17 22	20 51	20 56	21.56	26.01
Aug	20.64	32 26	25 89	21.51	21 57	22 26	21.26	20 76	21 76	19.76	17.32	14 54	17 79	20 51	20.56	21.56	26.01
Sept	21 22	34 83	26 26	21.76	21 96	22.26	20 76	21.01	21 76	19 56	16.86	14 34	18 59	20 51	20 56	21.56	26.01
Oct	22 23	32 54	24 04	21.76	22.64	22.26	20 51	21 26	21 76	19.26	16.64	14.28	18.51	20.51	20.56	21.56	26.01
Nov	22 74	30 39	23.01	22.64	23.64	23.56	20.26	21 64	21 76	19.01	16.07	14.09	18.51	20 51	21.56	21.81	25.01
Dec	21.82	28 86	24.26	24 56	24 26	23.39	20.26	21 76	21 46	18.26	16.01	13.84	19 51	20.51	21.56	22.56	26.06
Aver	*25.14*	*27.27*	*28.31*	*22.78*	*22.93*	*23.05*	*21 55*	*21 17*	*21 90*	*20.04*	*17.41*	*15.09*	*16.55*	*20.20*	*20.71*	*21.66*	*25.50*

Basic Pig Iron, Delivered Eastern Pennsylvania, Gross Ton

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	$33 51	$20.18	$27.80	$23 00	$24 25	$23 00	$21 50	$19.50	$[illegible] 75	$19 50	$17.25	$16.25	$13.50	$18 76	$19 76	$20.81	$22.26
Feb	30 65	19 84	28 19	22 69	23 88	23 00	21 19	19 50	19 88	19 44	17.25	16.25	13 50	18 76	19.76	20.81	22.51
March	26.15	22 61	29 56	21 81	23 55	22 10	20 85	19 50	20 25	19 06	17.25	16 00	13 50	18 76	19.76	20.81	24.86
April	25 00	21.00	30 81	21 50	22 31	21 75	20.75	19.50	20 25	18.90	17 13	16 00	14 09	18 91	19 76	20.81	25.26
May	25 00	24.00	30 60	21.00	21 13	21 75	20 75	19 10	20 25	18.75	17 00	16.00	15 29	19.76	19.79	20.81	25.26
June	24 63	25 00	28 14	21 00	21 50	21 45	20.75	19.00	20 25	18.75	17 00	16.00	16 09	19.76	19.81	20.81	25.26
July	22.38	25.75	26.60	20 20	21.50	21 00	20 75	18 95	20 20	18.45	16.75	15 50	16.59	19.76	19 81	20.81	25.26
Aug	19.70	27.23	25.00	20.00	20.50	20 95	20 15	18 75	19 75	18 25	16 75	14 20	17 24	19 76	19.81	20.81	25.26
Sept	19.19	30.83	25.00	20.00	20 70	20 75	20 00	18 88	19.75	18.15	16.75	13 50	17.84	19 76	19.81	20.81	25.26
Oct	20.50	29.30	24.20	20.00	21.25	20 69	20.00	19 45	19.75	17.75	16.75	13.50	17 76	19.76	19.81	20.81	25.26
Nov	20.70	27.83	22.88	21.13	22 39	22 60	19.60	19 75	19.75	17.75	16.39	13.50	17.76	19 76	20 81	21.06	25.26
Dec	20.63	27.31	23.13	23.41	23.00	22.00	19.25	20.05	19.55	17.75	16.25	13 50	18.76	19.76	20.81	21.81	25.31
Aver	*24.00*	*25.08*	*26 83*	*21.31*	*22.16*	*21.75*	*20 46*	*19.33*	*19.95*	*18.54*	*16.87*	*15 02*	*15.99*	*19.45*	*19.96*	*20.91*	*24.75*

No. 2 Foundry Pig Iron at Cleveland Furnace, Gross Ton

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	$33 40	$20.06	$27.37	$23 20	$23 37	$21.82	$19 00	$18.00	$19.00	$19 00	$17.50	$16 00	$15 00	$17.50	$18 50	$19.50	$21.00
Feb	30.22	20 06	28.50	24.00	23 49	21.88	18 63	18.00	19.00	19.00	17.50	16 00	15.00	17.50	18 50	19.50	21.25
March	27.80	21.55	31.65	24.00	23.97	21 31	19 40	18.00	19 00	19 00	17.20	15.70	15.00	17 50	18.50	19 50	23.60
April	26 62	20 81	32.02	23.75	22.32	20.35	19.37	18 00	19.00	18.88	17.00	15.50	15 00	18 00	18.50	19.50	24.00
May	25 50	23.75	31.71	22 75	20 37	19 50	19 00	18 00	19 00	18.50	17.00	15.50	15.30	18 50	18 50	19.50	24.00
June	24.00	24.06	29.96	21.00	19.62	19 19	18 70	17.88	19.00	18.50	17.00	15.50	15.50	18 50	18 50	19.50	24.00
July	21.31	24.75	26.94	19 75	19.50	19.00	18.50	17.50	19 00	18.00	17 00	15.50	16 00	18 50	18.50	19.50	24.00
Aug	20.50	31.31	25 90	20.06	19.50	19 00	18 50	17.50	19 00	18 00	17 00	15.50	16.70	18.50	18.50	19.50	24.00
Sept	20.75	35.94	25 37	20.31	19 50	19.00	18.50	17.88	19 00	17.60	17 00	15.00	17.50	18.50	18.50	19.50	24.00
Oct	20 75	33 59	24.75	20.50	20 05	19 37	18.38	18.13	19 00	17.50	17.00	15.00	17 50	18.50	18 50	19.50	24.00
Nov	20.56	29.97	22.85	20.81	21 82	20 10	18.00	19.00	19 00	17 50	17.00	15.00	17.50	18.50	19.50	19.75	24.00
Dec	19.95	26.85	22.56	21.88	21.76	19.88	18.00	19 00	19 00	17.50	16.60	15.00	17.50	18.50	19 50	20.50	24.00
Aver	*24.28*	*26.05*	*27.47*	*21.84*	*21.19*	*20.03*	*18.67*	*18.16*	*19.00*	*18.25*	*17.07*	*15.43*	*16.13*	*18.21*	*18.67*	*19 60*	*23.49*

No. 2 Foundry Pig Iron at Buffalo Furnace, Gross Ton

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	$32 38	$19 44	$26.94	$22.25	$23.00	$21 00	$18.50	$17.00	$18 00	$18.75	$17.50	$16.00	$16 00	$17 50	$18 50	$19.50	$21.00
Feb	30.50	18.87	27.56	22.25	22.75	21 00	17 39	17 00	18 39	18.50	17.50	16.00	16.00	17.50	18 50	19.50	21.25
March	29.00	18 30	29.05	21 81	22.12	21 00	17 05	17 00	18 50	18 50	17 50	16.00	16 00	17.50	18 50	19.50	23.60
April	26.15	20.81	29 56	21.37	20.65	21.00	17 50	17.00	18 50	18.50	17.50	16.00	16 00	17.50	18 50	19.50	24.00
May	25.62	22.62	29.40	20 25	19.00	20.75	17 50	17.00	18 50	18 50	17.13	16.00	16.00	18.50	18.50	19.50	24.00
June	23.42	23.05	29.06	19.37	19.00	19.60	17.39	17.00	18.75	18 50	17.00	16.00	16.00	18.50	18 50	19.50	24.00
July	20.87	24.50	26.00	19.00	18.85	19.00	16.94	17 00	19.50	18 50	17.00	16.00	16 50	18.50	18 50	19.50	24.00
Aug	19.50	30.70	24.95	19.19	18.72	19 00	16.20	17.00	19.50	18.50	17.00	16.00	17.10	18.50	18.50	19.50	24.00
Sept	20.00	33.94	24.87	19.37	18 75	19.00	16.25	17.00	19.50	18.50	17.00	16.00	17.50	18.50	18 50	19.50	24.00
Oct	20.37	31.12	23 06	19.05	19.40	19.00	16.88	17 10	19.50	17 75	17.00	16.00	17.50	18.50	18.50	19.50	24.00
Nov	19.12	27.80	20.87	20 50	21.19	19.00	17.00	17.88	19.50	17.50	17.00	16.00	17.50	18.50	19.50	19.75	24.00
Dec	19.30	25.50	21.56	22.62	21.50	19.00	17.00	18 00	19.50	17.50	16.80	16.00	17.50	18.50	19.50	20.50	24.00
Aver	*23.85*	*24.72*	*26.07*	*20.59*	*20.41*	*19.86*	*17.13*	*17.17*	*18.97*	*18.29*	*17.16*	*16.00*	*16.63*	*18.17*	*18.67*	*19.60*	*23.49*

No. 2 Foundry Pig Iron at Chicago Furnace, Gross Ton

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$31.50	$18.90	$28.90	$23.70	$24.00	$23.00	$20.88	$18.50	$20.00	$20.00	$17.50	$16.50	$15.50	$17.50	$18.50	$19.50	$21.00
Feb.	29.00	19.00	29.75	24.50	24.00	23.00	20.25	18.50	20.00	20.00	17.50	16.50	15.50	17.50	18.50	19.50	21.25
March	25.60	20.00	31.25	24.38	23.80	23.00	20.00	18.50	20.00	19.50	17.50	16.50	15.50	17.50	18.50	19.50	23.60
April	24.00	20.50	32.00	24.10	22.50	22.00	20.00	18.50	20.00	19.40	17.50	16.00	15.50	17.75	18.50	19.50	24.00
May	22.80	22.60	32.00	22.75	21.13	21.63	20.00	18.20	20.00	19.00	17.50	16.00	15.80	18.50	18.50	19.50	24.00
June	20.75	23.25	31.25	21.25	20.30	21.10	20.00	18.00	20.00	18.39	17.50	16.00	16.00	18.50	18.50	19.50	24.00
July	19.00	24.25	27.90	19.60	20.50	21.00	20.00	17.60	20.00	17.90	17.50	15.50	16.78	18.50	18.50	19.50	24.00
Aug	19.55	28.60	27.00	20.38	20.50	21.00	19.50	17.63	20.00	17.50	17.50	15.50	17.10	18.50	18.50	19.50	24.00
Sept	21.75	32.00	26.75	20.50	21.00	21.00	19.50	18.25	20.00	17.50	17.50	15.50	17.50	18.50	18.50	19.50	24.00
Oct.	21.00	31.40	25.00	20.50	21.63	21.00	19.00	18.80	20.00	17.50	17.00	15.50	17.50	18.50	18.70	19.50	24.00
Nov.	20.60	29.75	23.13	21.00	22.75	21.00	18.50	20.00	20.00	17.50	17.00	15.50	17.50	18.50	19.50	19.75	24.00
Dec.	19.63	28.00	23.00	22.50	23.00	21.00	18.50	20.00	20.00	17.50	16.70	15.50	17.50	18.50	19.50	20.50	24.00
Aver.	*22.93*	*24.85*	*28.16*	*22.10*	*22.09*	*21.64*	*19.68*	*18.54*	*20.00*	*18.47*	*17.35*	*15.87*	*16.47*	*18.19*	*18.68*	*19.60*	*23.49*

Malleable Pig Iron at Chicago Furnace, Gross Ton

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$32.00	$18.90	$28.90	$23.88	$24.00	$23.00	$20.88	$18.50	$20.00	$20.00	$17.50	$16.50	$15.50	$17.50	$18.50	$19.50	$21.00
Feb.	29.38	19.13	29.75	24.50	24.00	23.00	20.25	18.50	20.00	20.00	17.50	16.50	15.50	17.50	18.50	19.50	21.25
March	25.80	20.00	31.25	24.38	24.00	23.00	20.00	18.50	20.00	19.50	17.50	16.50	15.50	17.50	18.50	19.50	23.60
April	24.00	20.50	32.00	24.10	22.63	22.00	20.00	18.50	20.00	19.40	17.50	16.00	15.50	17.75	18.50	19.50	24.00
May	23.00	22.60	32.00	22.75	21.25	21.42	20.00	18.22	20.00	19.00	17.50	16.00	15.80	18.50	18.50	19.50	24.00
June	21.50	23.25	31.25	21.25	20.60	21.10	20.00	18.00	20.00	18.50	17.50	16.00	16.00	18.50	18.50	19.50	24.00
July	19.00	24.25	27.90	19.60	20.50	21.00	20.00	17.60	20.00	17.90	17.50	15.50	16.78	18.50	18.50	19.50	24.00
Aug.	19.60	28.60	27.00	20.38	20.50	21.00	19.50	17.63	20.00	17.50	17.50	15.50	17.10	18.50	18.50	19.50	24.00
Sept.	21.75	32.00	26.75	20.50	21.00	21.00	19.50	18.25	20.00	17.50	17.50	15.50	17.50	18.50	18.50	19.50	24.00
Oct.	21.00	31.40	25.00	20.50	21.63	21.00	19.00	18.80	20.00	17.50	17.10	15.50	17.50	18.50	18.70	19.50	24.00
Nov.	20.60	29.75	23.13	20.88	22.75	21.00	18.50	20.00	20.00	17.50	17.00	15.50	17.50	18.50	19.50	19.75	24.00
Dec.	19.63	28.00	23.00	22.62	23.00	21.00	18.50	20.00	20.00	17.50	16.70	15.50	17.50	18.50	19.50	20.50	24.00
Aver.	*23.11*	*24.87*	*28.16*	*22.11*	*22.15*	*21.63*	*19.68*	*18.54*	*20.00*	*18.48*	*17.36*	*15.87*	*16.47*	*18.19*	*18.68*	*19.60*	*23.49*

Lake Superior Charcoal Pig Iron at Chicago, Gross Ton

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$42.50	$31.10	$33.15	$29.15	$29.04	$29.04	$27.04	$27.04	$27.04	$27.04	$27.04	$23.17	$23.17	$23.54	$24.04	$25.25	$26.54
Feb.	39.50	29.38	33.90	29.15	29.04	29.04	27.04	27.04	27.04	27.04	27.04	23.17	23.17	23.54	24.04	25.25	26.79
March	38.50	26.00	35.40	29.15	29.04	29.04	27.04	27.04	27.04	25.04	26.24	23.17	23.17	23.54	24.04	25.25	29.44
April	38.50	26.50	36.53	29.15	29.04	29.04	27.04	27.04	27.04	27.04	25.04	23.17	23.17	24.79	24.13	25.25	30.04
May	37.50	28.40	36.65	29.15	29.04	29.04	27.04	27.04	27.04	27.04	25.04	23.17	23.17	24.04	24.25	25.25	30.04
June	37.50	29.75	36.65	29.12	29.04	29.04	27.04	27.04	27.04	27.04	25.04	23.17	23.17	24.04	24.25	25.25	30.04
July	36.37	31.65	34.81	29.04	29.04	29.04	27.04	27.04	27.04	27.04	25.04	23.17	23.17	24.04	24.25	25.25	30.04
Aug.	33.60	34.05	32.04	29.04	29.04	29.04	27.04	27.04	27.04	27.04	25.04	23.17	23.17	24.04	24.25	25.25	30.04
Sept.	33.00	36.15	32.04	29.04	29.04	29.04	27.04	27.04	27.04	27.04	25.04	23.17	23.67	24.04	24.25	25.25	30.04
Oct.	31.50	36.15	29.86	29.04	29.04	27.54	27.04	27.04	27.04	27.04	25.04	23.17	23.54	24.04	24.85	25.25	30.04
Nov.	31.50	36.15	28.40	29.04	29.04	27.54	27.04	27.04	27.04	27.04	25.04	23.17	23.54	24.04	25.25	25.50	30.16
Dec.	31.50	34.65	29.15	29.04	29.04	27.04	27.04	27.04	27.04	27.04	23.04	23.17	23.54	24.04	25.25	26.25	30.24
Aver.	*35.96*	*31.66*	*33.22*	*29.09*	*29.04*	*28.58*	*27.04*	*27.04*	*27.04*	*26.87*	*25.31*	*23.17*	*23.30*	*23.98*	*24.35*	*25.35*	*29.45*

Southern No. 2 Foundry Pig Iron at Birmingham, Gross Ton

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$32.25	$16.20	$23.25	$21.50	$20.00	$22.00	$18.50	$16.00	$16.50	$14.50	$13.80	$11.50	$11.00	$13.50	$14.50	$15.50	$17.38
Feb.	28.13	15.00	24.38	22.50	20.00	22.00	18.00	16.00	16.50	14.63	12.88	11.00	11.00	13.50	14.50	15.50	17.63
March	25.30	15.00	26.40	22.50	20.00	22.00	18.00	16.00	16.00	14.50	12.38	11.00	11.00	13.50	14.50	15.50	19.98
April	23.50	15.88	27.00	22.30	20.00	22.00	18.00	16.00	15.40	14.00	12.00	11.00	11.25	13.50	14.50	15.50	20.38
May	22.20	17.60	26.85	21.50	20.00	22.00	18.00	15.70	15.00	14.00	12.00	11.00	12.00	14.30	14.50	15.50	20.38
June	21.88	18.38	25.75	20.00	19.60	21.20	18.00	15.88	15.00	14.00	12.00	11.00	12.00	14.50	14.50	15.50	20.38
July	20.25	18.25	25.00	18.00	18.00	21.00	17.44	15.50	14.63	14.00	12.00	11.00	12.50	14.50	14.50	15.50	20.38
Aug.	19.00	20.10	23.70	17.50	18.00	21.00	17.25	15.69	14.50	14.00	12.00	11.00	13.10	14.50	14.50	*15.88	20.38
Sept.	19.00	26.00	22.75	17.50	18.50	20.75	17.25	16.25	14.50	14.00	12.00	11.00	13.50	14.50	14.50	15.88	20.38
Oct.	19.00	26.80	20.63	17.50	19.38	20.00	17.25	16.25	14.50	14.00	12.00	11.00	13.50	14.50	14.50	15.88	20.38
Nov.	18.40	23.50	19.60	17.75	21.00	20.00	16.00	16.39	14.50	14.00	12.00	11.00	13.50	14.50	14.75	16.13	20.38
Dec.	17.33	22.88	21.00	19.80	22.00	20.00	16.00	16.50	14.50	14.00	12.00	11.00	13.50	14.50	15.50	16.88	20.38
Aver.	*22.19*	*19.63*	*23.86*	*19.86*	*19.71*	*21.16*	*17.47*	*16.01*	*15.13*	*14.14*	*12.27*	*11.04*	*12.32*	*14.16*	*14.60*	*15.76*	*19.87*

*Commencing August, 1936, 38c. a ton deducted for 0.70 phosphorous and over.

Southern No. 2 Foundry Pig Iron at Cincinnati, Gross Ton

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$36.75	$20.70	$27.45	$25.55	$24.05	$25.69	$22.19	$19.69	$20.19	$17.69	$14.19	$14.07	$13.82	$18.13	$19.13	$20.20	$20.69
Feb.	32.63	20.00	28.68	26.55	24.05	25.69	21.69	19.69	20.19	17.19	14.19	13.82	13.82	18.13	19.13	20.20	20.94
March	29.80	19.50	30.80	26.55	24.05	25.69	21.69	19.69	19.69	16.69	14.19	13.82	13.82	18.13	19.13	20.20	23.29
April	28.00	20.38	31.05	26.35	24.05	25.69	21.69	19.69	19.09	16.69	14.19	13.82	14.32	18.13	19.13	20.20	23.69
May	26.70	22.10	30.75	25.55	24.05	25.69	21.69	19.39	18.69	16.69	14.69	13.82	15.96	19.13	19.13	20.20	23.69
June	26.38	23.00	29.30	24.05	23.25	24.59	21.69	19.56	18.69	16.69	14.69	13.82	16.51	19.13	19.20	20.20	23.69
July	24.75	22.30	28.85	22.05	22.18	24.19	21.13	19.19	17.99	16.39	14.69	13.82	17.01	19.13	19.20	20.20	23.69
Aug.	23.50	24.35	27.68	21.55	22.55	24.19	20.94	19.39	17.57	15.82	14.69	13.82	17.83	19.13	19.20	19.44	23.69
Sept.	23.50	29.55	26.55	21.55	22.85	24.07	20.94	19.94	17.19	15.49	14.69	13.82	18.23	19.13	19.20	19.44	23.69
Oct.	23.50	30.85	24.68	21.55	23.43	23.69	20.94	19.94	17.30	15.19	14.69	13.82	18.13	19.13	19.20	19.44	23.69
Nov.	22.90	27.55	23.65	21.80	24.87	23.69	19.69	20.07	17.69	14.94	14.69	13.82	18.13	19.13	20.20	19.69	23.81
Dec.	21.75	26.93	25.05	23.85	25.49	23.69	19.69	20.19	17.69	14.39	14.69	13.82	18.13	19.13	20.20	20.44	23.89
Aver.	*26.68*	*23.93*	*27.87*	*23.91*	*23.74*	*24.71*	*21.16*	*19.70*	*18.51*	*16.16*	*14.52*	*13.84*	*16.31*	*18.80*	*19.34*	*19.99*	*23.20*

Ferroalloy Quotations

Ferromanganese (80 Per Cent), Gross Ton, at Seaboard

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	*$112.50	$58.35	$105.00	$108.70	$112.50	$115.00	$100.00	$100.00	$105.00	$100 00	$80.00	$75.00	$68.00	$85.00	$85.00	$75.00	$80.00
Feb.	100.00	60.42	107.50	107.50	115.00	115.00	100.00	100.00	105.00	95.50	80.00	75.00	68.00	85.00	85.00	75.00	80.00
March	96.00	62.50	113.75	107.50	115.00	97.60	100.00	100.00	105 00	94.00	80.00	75.00	68.00	85.00	85.00	75.00	89.00
April	90.00	64.37	120.00	107.50	115.00	88.00	100.00	100.00	105.00	94.00	80.00	75.00	68.00	85.00	85.00	75.00	95.00
May	85.00	66.87	128.00	107.50	115.00	88.00	94.00	103.00	105.00	94.00	80 00	75.00	68.00	85.00	85.00	75.00	100 62
June	80.00	67.50	128.75	107.50	115.00	88.00	90.00	105.00	105.00	94.00	80.00	68.00	68.00	85.00	85.00	75.00	102.50
July	70.60	67.50	*119.50	106.50	115.00	88.00	90.00	105.00	105.00	94.00	80.00	68.00	82.00	85.00	85.00	75.00	102.50
Aug.	70.00	67.50	117.50	95.75	115.00	88.00	90.00	105.00	105.00	94.00	80.00	68.00	82.00	85.00	85.00	75.00	102.50
Sept.	65.80	75.63	*111.25	90.00	115.00	88.00	90.00	105.00	105.00	94.00	80.00	68.00	82.00	85.00	85.00	75.00	102.50
Oct.	63.00	100.00	*110.00	90.00	115.00	88.00	90.00	105.00	105.00	94.00	80.00	68.00	82.00	85.00	85.00	75.00	102.50
Nov.	61.50	100.00	*108.75	98.75	115.00	96.60	90.00	105.00	105.00	94.00	80.00	68.00	82.00	85.00	85.00	80.00	102.50
Dec.	60.00	100.00	*108.25	107.00	115.00	100.00	100.00	105.00	105.00	82.80	73.60	68.00	82.00	85.00	85.00	80.00	102.50
Aver.	*79.63*	*74.22*	*114.85*	*102.85*	*114.79*	*95.02*	*94.50*	*103.17*	*105.00*	*93.70*	*79.47*	*70.92*	*75.00*	*85.00*	*85.00*	*75.83*	*96.84*

*Price at furnace, where lower than price at seaboard.

Spiegeleisen (19 to 21 Per Cent), Gross Ton, at Furnace

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$45.00	$26.00	$34.40	$38 00	$33.00	$32.00	$37.00	$30.80	$31 00	$31.00	$28.00	$26.00	$24.00	$27.00	$26.00	$26.00	$26.00
Feb.	40.00	38.00	35.50	38.00	33.00	32.00	37.00	31.00	31.00	31.00	28.00	26.00	24.00	27.00	26.00	26.00	26.00
March	35.00	29.40	40.00	38.00	33.00	32.00	37.00	31.00	31.00	31.00	28 00	26.00	24.00	26 50	26.00	26.00	28.40
April	34.00	32.25	45.00	36.80	33.00	32.00	37.00	31.00	31.00	31.00	28.00	26.00	24.00	26.00	26.00	26.00	30.00
May	32.00	35.00	52.50	36.00	33.00	32.00	36.25	31.00	31.00	31.00	28.00	26.00	24.00	26.00	26.00	26.00	32.25
June	32.00	36.00	48.50	35.00	32.80	32.00	35.50	31.00	31.00	31.00	28.00	25.75	24.00	26.00	26.00	26.00	33.00
July	27.00	36.00	44.00	34.20	32.00	32.00	33.50	31.00	31.00	31.00	28.00	25.00	27.00	26.00	26.00	26.00	33.00
Aug.	26.00	37.80	46.75	32.50	32.00	32.00	33.00	32.50	31.00	31.00	28.00	25.00	27.00	26.00	26.00	26.00	33.00
Sept.	26.00	38.25	43.75	31.40	31.80	32.00	33.00	33.00	31.00	31.00	28.00	25.00	27.00	26.00	26.00	26.00	33.00
Oct.	26.00	38.00	43.75	30.75	31.25	32.00	30.75	33.00	31.00	31 00	28.00	25.00	27.00	26.00	26.00	26.00	33.00
Nov.	26.00	37.50	41.25	30.25	32.00	37.40	30.00	30.00	31.00	30.50	28.00	24.40	27.00	26.00	26.00	26.00	33.00
Dec.	26.00	37.50	39.00	32.00	32.00	36.50	30.00	31.00	31.00	28.40	26.20	24.00	27.00	26.00	26.00	26.00	33.00
Aver.	*31.25*	*34.21*	*42.87*	*34.41*	*32.40*	*32.83*	*34.17*	*31.36*	*31.00*	*30.74*	*27.85*	*25.35*	*25.50*	*26.21*	*26.00*	*26.00*	*31.14*

50 Per Cent Ferrosilicon, Carloads, Gross Ton, Delivered East of Mississippi River

	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$54 00	$82.50	$75.00	$82.50	$85.00	$85.00	$83.50	$83.50	$83.50	$83.50	$77.50	$74.50	$77.50	$77.50	$77.50	$69.50
Feb.	55.00	83.75	75.00	82.50	85.00	85.00	83.50	83.50	83.50	83.50	77.50	74.50	77.50	77.50	77.50	69.50
March	55.00	90.00	75.00	82.50	85.00	85.00	83.50	83.50	83.50	83.50	77.50	74.50	77.50	77.50	77.50	69.50
April	55.00	92.50	75.00	82.50	85.00	85.00	83.50	83.50	83.50	83.50	77.50	74.50	77.50	77.50	77.50	69.50
May	55.00	94.50	75.00	82.50	85.00	85.00	83.50	83.50	83.50	83.50	77.50	74.50	77.50	77.50	77.50	69.50
June	55.00	90 00	75.00	82 50	85.00	85.00	83.50	83.50	83.50	83.50	77.50	74.50	77.50	77.50	77.50	69.50
July	55.00	82 50	71.00	82.50	85.00	85.00	83.50	83.50	83.50	83.50	77.50	74.50	77.50	77.50	69.50	69.50
Aug.	55.00	82.50	71.25	82.50	85.00	85.00	83.50	83.50	83.50	83.50	77.50	74.50	77.50	77.50	69.50	69.50
Sept.	55.00	82.50	72.00	82.50	85 00	85.00	83.50	83.50	83.50	83.50	77.50	74.50	77.50	77.50	69.50	69.50
Oct.	67.00	81.00	71.00	82.50	85 00	85.00	83.50	83.50	83.50	83.50	77.50	74.50	77.50	77.50	69.50	69.50
Nov.	75.00	80 63	70.00	82.50	85 00	85.00	83.50	83.50	83.50	83.50	77.50	74.50	77.50	77.50	69.50	69.50
Dec.	82.50	76.25	65.00	82.50	85 00	85.00	83.50	83.50	83.50	83.50	77.50	74.50	77.50	77 50	69.50	69.50
Aver.	*59.88*	*84.89*	*73.35*	*82.50*	*85.00*	*85.00*	*83.50*	*83.50*	*83.50*	*83.50*	*77.50*	*74.50*	*77.50*	*77.50*	*73.50*	*69.50*

Connellsville Coke Prices

Prompt Connellsville Furnace Coke, Net Ton at Oven

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$6.00	$5.65	$6.00	$5.06	$2.75	$8.05	$3.94	$3.94	$7.19	$3.50	$2.70	$2.75	$2.55	$2.50	$2.25	$1.75	$3.60	$3.85	$3.65	$4.00
Feb.	6.00	4.44	6.00	4.50	3.04	7.13	4.08	3.63	7.31	3.38	2.68	2.90	2.60	2.50	2.25	1.75	3.50	3.85	3.65	4.06
March	6.00	4.06	6.00	4.35	3.25	7.25	4.08	3.35	3.05	3.35	2.60	2.98	2.60	2.50	2.25	1.75	3.50	3.85	3.65	4.25
April	6.00	3.65	9.60	3.50	4.48	6.31	3.75	3.04	3.00	3.20	2.60	2.78	2.60	2.50	2.25	1.75	3.85	3.85	3.65	4.51
May	6.00	3.69	12.00	3.25	6.00	5.15	3.25	3.00	2.91	2.94	2.60	2.75	2.53	2.45	2.20	1.75	3.85	3.85	3.65	4.60
June	6.00	4.00	15.00	3.00	6.75	4 75	3.19	2.77	2.83	2.93	2.60	2.75	2.50	2.40	2.00	1.81	3.85	3.59	3.65	4.58
July	6.00	4.07	17.20	2 81	10.75	4.55	3.00	2.83	2.84	3.00	2.63	2.75	2.50	2.40	2.00	2.31	3.85	3.27	3.50	4.35
Aug.	6.00	4.31	17.75	2.75	12.80	4 56	3.00	3.06	2.95	3.00	2.75	2.73	2.58	2.40	2 00	2.55	3.85	3.29	3.61	4.35
Sept.	6.00	4.56	16.70	3.15	11.13	4.50	3.00	3.49	3.38	2.85	2.75	2.65	2.60	2.40	2.00	2.50	3.85	3.25	3.69	4.27
Oct.	6.00	4.52	15.12	3.28	9.60	3.85	3.00	6.13	3.63	2.85	2.83	2.65	2.60	2.40	1.81	3.50	3.85	3.53	3.75	4.25
Nov.	6.00	5.87	8.26	3.03	7.19	3.81	3.04	5.75	4.43	2.77	2.75	2.65	2.53	2.40	1.75	3.75	3.85	3.60	3.75	4.25
Dec.	6.00	6.12	6.20	2.75	7.00	4.00	3.68	4.32	3.50	2.75	2.75	2.63	2.50	2 34	1.75	3.75	3.85	3.57	3.92	4.00
Aver.	*6.00*	*4.58*	*11.32*	*3.45*	*7.01*	*5.55*	*3.42*	*3 78*	*3.92*	*3.04*	*2.69*	*2.75*	*2.56*	*2 43*	*2.04*	*2.41*	*3.79*	*3.61*	*3.68*	*4.29*

Prompt Connellsville Foundry Coke, Net Ton at Oven

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$7.00	$6.25	$7.00	$6.38	$3.75	$8.70	$4.75	$4.88	$7.75	$4.50	$3.75	$3.75	$3.50	$3.50	$3.50	$2.50	$4.25	$4.60	$4.25	$4.50
Feb.	7.00	5.00	7.00	5.63	4.00	8.25	4 88	4.31	8.31	4.31	3.75	3.75	3.50	3.50	3.50	2.50	4.25	4.60	4.25	4.50
March	7.00	4.94	7.00	5.45	4.25	8.38	4.88	4.15	4.40	4.40	3.75	3.75	3.50	3.50	3.50	2.50	4.25	4.60	4.25	4.50
April	7.00	4.30	10.20	4.75	5.06	7.56	4.75	4.00	4.06	4.06	3.75	3.75	3.50	3.50	3.50	2.50	4.60	4.60	4.25	5.00
May	7.00	4.31	13.00	4.50	6.30	6.15	4.69	4.00	4.00	4.00	3.75	3.75	3.50	3.50	3.10	2.50	4.60	4.60	4.25	5.25
June	7.00	4.56	15.75	4.45	7.25	5.56	4.38	4.80	4 00	4.00	3.75	3.75	3.50	3.50	3.00	2.56	4.60	4.15	4.25	5.25
July	7.00	5.00	17.80	4.06	11.00	5.35	4.10	3.75	4 00	4.00	3.75	3.75	3.50	3.50	3.00	2.94	4.60	3.88	4.00	5.00
Aug.	7.00	5.25	18.88	3.75	13.90	5.38	4.00	3.88	4.00	4.00	3.75	3.75	3.50	3.50	2.90	3.15	4.60	4.00	4.00	5.00
Sept.	7.00	5.80	17.70	4.15	12.50	5.50	4.00	4.25	4 38	4.00	3.75	3.75	3.50	3.50	2.75	3.25	4.60	4.00	4.05	5.00
Oct.	7.00	6.25	17.38	4.38	11.70	4.80	4.00	6.31	4.63	4 00	3.75	3.75	3.50	3.50	2.75	4.05	4.60	4.20	4.25	5.00
Nov.	7.00	7.00	9.50	4.19	8.38	4.81	4.06	6.81	5.50	3 85	3.75	3.75	3.50	3.50	2.75	4.25	4.60	4.25	4.25	5.00
Dec.	7.00	7.00	7.00	3.81	7.88	4.81	4.55	5.20	4.50	3 75	3.75	3.50	3.50	3.25	2.69	4.25	4.60	4.15	4.40	5.00
Aver.	*7.00*	*5.47*	*12.27*	*4.63*	*8.00*	*6.27*	*4.42*	*4.81*	*4.96*	*4.11*	*3.75*	*3.73*	*3.50*	*3.48*	*3.08*	*3.08*	*4.51*	*4.30*	*4.20*	*4.92*

Monthly Average Steel Prices Computed From

Composite Price of

Average of The Iron Age quotations on steel bars, shapes, sheets for period prior to 1920; hot-rolled strip ad

	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919
Jan.	2.026	1.921	1 740	1.713	1 747	1 887	1 923	1 820	1 741	1 615	1 424	1 771	1 451	1 383	2 060	3 384	3 549	3.371
Feb.	2.005	1.875	1 751	1.725	1 749	1 899	1 920	1 772	1 736	1 620	1 400	1 766	1 477	1 395	2 203	3 501	3 549	3.371
March	2.075	1.886	1 769	1.783	1 746	1 905	1 920	1 599	1 727	1 623	1 394	1 786	1 473	1 413	2 447	3 739	3.549	3.282
April	2.083	1.886	1 764	1.793	1 741	1 931	1 920	1.577	1 727	1 627	1 433	1 790	1 446	1 437	2 611	4 110	3 549	3.031
May	2.064	1 886	1 757	1 799	1 741	1 933	1 920	1 506	1 720	1 620	1 456	1 727	1 424	1 433	2 750	4 562	3 549	3 021
June	2.070	1.886	1 737	1 779	1 763	1.927	1 851	1 506	1.707	1 556	1 470	1 687	1.399	1.444	2 689	5 004	3 549	3.021
July	2.106	1.884	1 702	1 779	1.763	1 927	1 820	1 543	1.657	1 546	1 504	1 667	1 400	1.471	2 640	5 334	3 549	3.021
Aug.	2.136	1.879	1 674	1 783	1 763	1 927	1 820	1.581	1.636	1 539	1 553	1 624	1 446	1 511	2 682	5 249	3.549	3.021
Sept.	2.126	1.871	1 621	1.786	1 763	1 934	1 820	1.616	1 627	1 513	1 610	1 591	1 470	1 559	2.765	5 049	3.549	3 004
Oct.	2 047	1.867	1 620	1 720	1 780	1 934	1 820	1.664	1 613	1 441	1 659	1 559	1 446	1 634	2.856	3 470	3 55	3 052
Nov.	1 991	1 812	1 652	1 723	1 820	1.934	1.820	1.674	1 613	1 407	1.700	1 505	1.397	1.769	3.021	3 444	3.549	3.084
Dec.	1.953	1.761	1.691	1.727	1.870	1.934	1 820	1.727	1.611	1.399	1.725	1.463	1.366	1.941	3,278	3.441	3 461	3.110
Aver.	*2.057*	*1.868*	*1.707*	*1.760*	*1.770*	*1.923*	*1.865*	*1.632*	*1.676*	*1.542*	*1.527*	*1.661*	*1.433*	*1.533*	*2.667*	*4.191*	*3 542*	*3.115*

Open-Hearth Steel Billets at Pittsburgh, Gross Ton

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$43.50	$28.00	$37.50	$40 00	$38.00	$35.00	$35 00	$33 00	$33 00	$34.00	$30.00	$27.75	$26 00	$26 00	$27.00	$29 00	$34.00
Feb.	41 00	28 00	39.63	40 00	38 00	35 00	33 00	33.00	33 25	33 00	30 00	27 00	26.00	26 00	27 00	29 00	34.00
March	38.50	28 00	44.39	40 00	36 70	35 00	34 00	33 00	34 00	33 00	30 00	27 00	26.00	26.00	27.00	28.20	36.40
April	37.50	29.50	45.00	40 00	35.50	35.00	33.25	33 00	34.80	33 00	30 00	27 00	26.00	26.75	27.00	28.00	37.00
May	37.00	34 00	45.00	38.50	35 25	35 00	33 00	33.00	36.00	32.50	29 50	27.00	26.00	29 00	27.00	28.00	37.00
June	37.00	35.00	42.63	38.00	35 00	35.00	33 00	32.25	35.25	31 00	29 00	26 50	26.00	29.00	27.00	28.00	37.00
July	32.25	35.00	42 50	38.00	35 00	35 00	33.00	32.00	35 00	31 00	29 00	26 00	26.00	27.40	27 00	30.00	37.00
Aug.	29.60	35.50	42 50	37 75	35 00	35 00	33 00	32.00	35 00	31.00	29.00	26.00	26.00	27 00	27.00	30.00	37.00
Sept.	29.00	39 50	41.88	36.40	35 00	35 00	33.00	32 00	35 00	31.00	29.00	26.00	26.00	27.00	27.00	30.00	37.00
Oct.	29.00	40 00	40 00	35.75	34.25	35 00	33.00	32 80	35.00	31.00	29 00	26 00	26.00	27.00	27.00	32.00	37.00
Nov.	29.00	37.75	40 00	35.50	34.75	35 00	33.00	33 00	35.00	31.00	29 00	26.00	26.00	27 00	28.00	32.00	37.00
Dec.	29.00	36.50	44.00	36.00	35.00	35.00	33.00	33.00	34.60	30.60	28.80	26.00	26.00	27.00	29.00	32.00	37.00
Aver.	*34.36*	*33.90*	*41.75*	*37.99*	*35.62*	*35.00*	*33 27*	*32.67*	*34.66*	*31.84*	*29 36*	*26.51*	*26.00*	*27.10*	*27 25*	*29.68*	*36.45*

Wire Rods at Pittsburgh, Gross Ton

Quotations apply to both open-hearth and bessemer rods

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$57 00	$36 00	$47.00	$51 00	$48 00	$45.00	$45 00	$41 60	$42 00	$40 00	$35 00	$37.00	$35 80	$36 00	$38.00	$40 00	$43.00
Feb.	54 50	35 75	49.38	51 00	48 00	45.00	43 00	43 00	42 00	39.75	35 00	37.00	35 00	36.00	38.00	40.00	43.00
March	52.00	36 00	50.00	51 00	48 00	45.00	43 00	44 00	42.00	38 00	35 00	37.00	35 00	36 00	38.00	38.40	46.20
April	49 00	38 00	50.25	51.00	47.00	45 00	42.25	44.00	42.00	38.00	35 00	37.00	35 00	36.50	38.00	38.00	47.00
May	48.00	38.00	51.00	48.75	46.00	45.00	42 00	44.00	42.00	36.00	35 00	37 00	35.00	38 00	38.00	38.00	47.00
June	48.00	38.50	51.00	48.00	45 60	45.00	42 00	42 00	42.00	36 00	35 00	37 00	35.00	38.00	38.00	38 00	47.00
July	43.00	40.00	51.00	48.00	45 00	45.00	42 25	42 00	42.00	36 00	35 00	37 00	35 00	38 00	38.00	38 00	47.00
Aug.	41 80	42.40	51.00	46.50	45 00	45.00	43.00	42.00	42.00	36.00	35 00	37 00	35.00	38.00	38.00	38.00	47.00
Sept.	39 50	46.25	51.00	46.00	45 00	45 00	43.00	42.00	42.00	36.00	35 00	37 00	35.00	38 00	38.00	38.00	47.00
Oct.	40 50	45.00	51.00	45.50	45.00	45.00	42.75	42.00	40.00	36.00	35.00	37 00	35.00	38.00	38.00	40.00	47.00
Nov.	40 00	45.00	51.00	45.00	45.00	45.00	41.00	42.00	40 00	36.00	35 00	37.00	35.00	38 00	38.50	40.00	47.00
Dec.	38.00	45.00	51.00	48.00	45.00	45.00	40.00	42.00	40.00	35.20	35.40	37.00	36.00	38.00	40.00	43 00	47.00
Aver.	*45.94*	*40.49*	*50.39*	*48.31*	*46.05*	*45.00*	*42.44*	*42.55*	*41.50*	*36.91*	*35.03*	*37.00*	*35 15*	*37.37*	*38.21*	*39 12*	*46.27*

Steel Rails at Mill, Open-Hearth, Gross Ton

The extra $2 a gross ton, which was for many years charged for open-hearth rails, was annulled with the rail price announced Oct. 22, 1921

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$47 00	$40.00	$43.00	$43.00	$43 00	$43 00	$43 00	$43.00	$43.00	$43.00	$43.00	$43.00	$40.00	$36.375	$36.375	$36.375	$39.00
Feb.	47 00	40.00	43 00	43 00	43 00	43.00	43 00	43 00	43.00	43.00	43.00	43 00	40 00	36.375	36.375	36.375	39 00
March	47 00	40.00	43 00	43 00	43.00	43.00	43 00	43 00	43 00	43.00	43.00	43.00	40 00	36.375	36.375	36.375	41.80
April	47.00	40.00	43.00	43.00	43 00	43.00	43 00	43.00	43.00	43 00	43 00	43.00	40 00	36.375	36 375	36.375	42.50
May	47.00	40.00	43.00	43.00	43 00	43 00	43 00	43.00	43.00	43.00	43.00	43.00	40 00	36.375	36 375	36.375	42.50
June	47.00	40.00	43.00	43.00	43 00	43 00	43 00	43.00	43.00	43.00	43.00	43.00	40 00	36 375	36 375	36 375	42.50
July	47.00	40.00	43.00	43.00	43 00	43.00	43 00	43.00	43.00	43.00	43.00	43.00	40 00	36 375	36 375	36 375	42.50
Aug.	47 00	40.00	43 00	43 00	43 00	43 00	43 00	43 00	43 00	43 00	43 00	43 00	40 00	36 375	36 375	36.375	42.50
Sept.	47.00	40.00	43.00	43.00	43.00	43.00	43 00	43.00	43.00	43.00	43.00	43 00	40 00	36 375	36 375	36 375	42.50
Oct.	45.25	43.00	43 00	43 00	43.00	43.00	43 00	43.00	43.00	43.00	43.00	42.25	39 55	36 375	36 375	36.375	42.50
Nov.	40.00	43.00	43.00	43 00	43 00	43.00	43 00	43.00	43.00	43.00	43.00	40 00	36.38	36.375	36.375	36.375	42.50
Dec.	40.00	43.00	43.00	43 00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	40 00	36.38	36.375	36.375	39.00	42.50
Aver.	*45.69*	*40.75*	*43.00*	*43.00*	*43.00*	*43.00*	*43.00*	*43.00*	*43.00*	*43.00*	*43.00*	*42.44*	*39.96*	*36.375*	*36 375*	*38 592*	*41.86*

Standard Steel Pipe at Pittsburgh, Net Ton

Computed from list discounts, for carload lots; price for base size pipe, 1 to 3 in., ¾ to 3 in. prior to April 13, 1931

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$77.30	$51.87	$61.13	$70.30	$70.30	$70.30	$70.30	$68.60	$70.30	$70.30	$66.50	$64.84	$65.00	$61.75	$68.40	$68.40	$61.00
Feb.	76 88	51.87	66.50	70.30	70.30	70 30	70.30	68.60	70.30	70.30	66.50	64 84	65.00	61 75	68.40	64.98	61.00
March	76.88	51 87	66.50	70.30	70.30	70 30	70.30	68.60	70.30	70.30	66 50	64.84	65 00	61 75	68.40	61.80	69.00
April	71.63	51.87	68.02	70.30	70.30	70.30	70.30	69.88	70.30	66.50	66.50	64.84	58 00	63 41	68.40	61 00	71.00
May	67.62	51.87	70.30	70.30	70.30	70.30	70 30	70.30	70 30	66.50	63 59	64 84	58.00	68 40	68 40	61 00	71 00
June	67 82	51.87	70.30	70.30	70.30	70.30	70 30	70 30	70.30	66.50	64 84	64 84	58 00	68 40	68.40	61 00	71.00
July	64 63	51.87	70.30	70 30	70.30	70.30	70 30	70 30	70.30	66 50	64.84	64 84	61 75	68 40	68 40	61 00	71.00
Aug.	63 91	54.74	70.30	70 30	70.30	70 30	70 30	70 30	70 30	66 50	64 84	64 84	61 75	68 40	68 40	61 00	71.00
Sept.	60 21	57.43	70.30	70 30	70.30	70 30	70 30	70 30	70 30	66 50	64 84	65 00	61 75	68 40	68 40	61 00	71.00
Oct.	56 50	58.74	70 30	70 30	70.30	70 30	68 54	70 30	70 30	66.50	64 84	65 00	61 75	68 40	68 40	61 00	71.00
Nov.	56 50	61.13	70 30	70 30	70.30	70 30	66 79	70 30	70 30	66 50	64 84	65 00	61 75	68 40	68 40	61 00	71.00
Dec.	53 96	61.13	70 30	70 30	70.30	70.30	66.79	70.30	70.30	66.50	64 84	65 00	61.75	68 40	68 40	61.00	71.00
Aver.	*66.14*	*54.69*	*68.71*	*70.30*	*70.30*	*70.30*	*69.57*	*69.84*	*70.30*	*67.15*	*65.29*	*64.84*	*61.63*	*66.32*	*68.40*	*62.01*	*69.17*

Weekly Market Quotations In THE IRON AGE

Finished Steel

plates, plain wire, open-hearth rails, black pipe and black ded for subsequent period. Quoted in cents a pound

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	3.202	3.087	2.052	2 494	2 81	2 521	2 429	2 365	2 224	2 286	2.231	2 032	1.937	1 930	2.008	2.124	2.130	2 330
Feb	3 628	2 965	2 002	2 637	2 808	2 521	2 412	2 296	2 271	2 286	2 212	2 037	1.926	1 923	2 008	2.124	2.109	2 330
March	3 916	2 787	1 995	2 768	2 767	2.52	2 416	2 302	2 273	2.286	2.215	2 032	1.939	1 923	2.008	2.124	2.089	2.550
April	4 08	2 74	2 063	2 87	2 696	2 465	2 421	2 296	2 27	2 317	2.158	2 024	1 97	1.873	2 056	2.124	2.097	2.605
May	4 015	2.762	2.123	2.856	2 647	2 427	2 401	2.296	2 249	2 317	2 124	2 012	1 97	1.877	2.199	2 124	2.097	2.605
June	3 974	2.64	2 18	2 852	2 596	2 41	2.405	2.304	2 236	2.317	2.11	2 008	1.971	1.895	2.199	2.124	2.102	2.605
July	4 087	2.523	2.211	2.832	2 555	2 405	2.415	2 302	2 222	2 317	2 079	2 024	1.976	1.953	2.141	2.124	2.159	2.605
Aug	4.171	2 346	2.325	2.802	2.494	2 39	2.415	2.302	2 242	2 307	2.062	2 014	1.971	1.958	2 124	2.124	2.159	2.605
Sept	4 165	2 239	2.461	2.802	2.457	2 372	2 39	2.293	2 242	2 301	2 053	2 014	1.965	1.962	2 124	2.124	2.167	2.605
Oct	3 987	2 206	2 516	2 802	2 437	2 382	2.399	2 246	2 263	2 28	2.038	2 013	1.97	2.013	2.124	2.130	2.197	2.605
Nov	3.717	2.131	2.49	2.802	2.452	2.416	2.402	2.216	2.274	2.273	2.035	2 008	1.948	1.995	2.124	2.130	2.197	2.605
Dec	3.18	2 094	2.471	2 786	2 504	2 431	2 402	2.217	2.281	2 273	2.021	1 978	1.948	2.008	2.124	2.130	2.280	2.605
Aver	*3.843*	*2.543*	*2.241*	*2.775*	*2 602*	*2.458*	*2.409*	*2 286*	*2.254*	*2 297*	*2.111*	*2.016*	*1.957*	*1.943*	*2.103*	*2.126*	*2.148*	*2.555*

Structural Shapes at Pittsburgh, Cents a Pound

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	3.00	2 80	2.47	2.45	1.50	2.06	2.50	2 10	1.90	1.98	1.81	1.90	1.83	1.64	1.50	1.60	1.70	1.80	1.80	2 05
Feb	3.00	2.80	2.70	2 26	1.39	2.20	2.50	2.10	1 90	1.90	1 85	1.90	1.80	1.65	1.50	1.60	1.70	1.80	1.80	2 05
March	3.00	2.71	3.13	2.08	1.39	2.39	2.39	2.10	1 90	1.90	1.85	1.90	1 80	1.65	1.52	1.60	1.70	1.80	1.80	2 21
April	3.00	2.45	3.25	2.10	1.50	2.50	2.29	2.05	1.90	1.88	1.85	1.95	1.80	1.65	1.60	1.60	1.74	1.80	1.80	2 25
May	3.00	2 45	3.10	2.20	1.56	2.50	2.24	2.00	1 90	1.80	1.85	1.95	1.73	1.65	1.60	1.60	1.85	1.80	1.80	2 25
June	3.00	2.45	3.10	2.10	1.63	2.50	2.20	2.00	1.94	1.80	1.85	1.95	1.69	1.65	1 60	1.60	1.85	1.80	1.80	2 25
July	3.00	2.45	3.10	1.93	1.70	2.50	2.09	2.00	2.00	1 80	1.85	1.95	1.65	1.63	1.60	1.60	1 81	1.80	1.90	2 25
Aug	3.00	2.45	3.10	1.82	1.88	2.50	2.00	1.95	2.00	1.80	1.90	1.95	1.61	1.60	1 60	1 60	1.80	1.80	1.90	2 25
Sept	3.00	2.45	3.10	1.64	2.00	2.50	2.00	1.90	2.00	1.78	1.90	1.95	1.60	1 60	1 60	1.60	1.80	1.80	1.90	2 25
Oct	3.00	2.45	3.05	1.60	2.00	2.50	1.93	1.90	2.00	1.75	1.90	1.90	1.60	1.60	1.60	1 70	1.80	1.80	1.90	2 25
Nov	3.00	2.45	2.89	1.54	2.00	2.50	2.00	1.90	2.00	1.77	1.90	1.90	1.60	1.60	1.60	1.70	1.80	1.80	1.90	2 25
Dec	2.90	2.45	2.45	1.50	2.00	2.50	2.10	1.90	2 00	1.80	1.90	1.90	1.60	1.50	1.60	1.70	1.80	1.80	1.90	2 25
Aver	*2.99*	*2.52*	*2 95*	*1.94*	*1.71*	*2.43*	*2.19*	*1 99*	*1.95*	*1.85*	*1.87*	*1.98*	*1.69*	*1.62*	*1.57*	*1.68*	*1.78*	*1 80*	*1 85*	*2 21*

Plates at Pittsburgh, Cents a Pound

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	3.25	3.00	2.72	2.65	1.48	2.06	2.50	2.00	1.86	1 90	1.81	1.90	1 83	1.64	1.50	1.60	1.70	1.80	1.80	2 05
Feb	3.25	3.00	3 50	2.33	1.39	2.23	2.45	2 00	1.80	1.86	1 85	1.90	1.80	1.65	1.50	1.60	1.70	1 80	1.80	2 05
March	3.25	2.91	3.63	2.04	1.39	2.39	2.39	2.00	1.86	1.85	1.85	1.90	1.80	1.65	1.52	1.60	1.70	1.80	1.80	2 21
April	3.25	2 65	3.75	2.10	1.48	2.50	2.28	2.00	1 90	1.85	1 85	1.95	1.80	1.65	1.60	1.55	1 74	1.80	1.80	2 25
May	3.25	2.65	3.75	2.20	1.56	2.50	2.20	2.00	1.86	1.84	1.85	1.95	1.73	1.65	1.60	1.50	1.85	1.80	1.80	2 25
June	3.25	2.65	3.55	1.95	1.63	2.50	2 18	1 92	1.88	1.80	1.85	1.95	1 69	1.65	1.60	1.53	1.85	1.80	1.80	2 25
July	3.25	2.65	3.38	1.85	1.70	2.50	2.09	1.90	1.90	1.80	1.85	1.95	1.65	1.63	1.60	1.60	1.81	1.80	1.90	2 25
Aug	3.25	2.65	3.25	1.78	1.88	2.50	1.95	1.85	1.90	1.80	1.90	1.95	1.61	1.60	1.60	1.60	1.80	1.80	1.90	2 25
Sept	3.25	2.53	3.25	1.64	2 13	2.50	1.82	1.80	1.90	1.78	1.90	1.95	1.60	1.60	1.60	1.60	1.80	1.80	1.90	2 25
Oct	3.25	2.61	3.09	1.60	2.11	2.50	1.80	1.80	1.90	1.75	1.90	1.94	1.60	1.60	1.60	1.70	1 80	1.80	1.90	2 25
Nov	3.25	2.65	2.81	1.54	1.99	2.50	1.83	1 86	1.90	1.77	1.90	1.90	1.60	1.60	1.60	1.70	1.80	1 80	1 90	2 25
Dec	3.13	2.65	2.65	1.50	1.95	2.50	1.92	1.90	1.90	1.80	1.90	1.90	1.60	1.54	1.60	1.70	1.80	1 80	1 90	2 25
Aver	*3.24*	*2.72*	*3.28*	*1.93*	*1.72*	*2.43*	*2.12*	*1.91*	*1.88*	*1.82*	*1.87*	*1.95*	*1.69*	*1.62*	*1.57*	*1.61*	*1.78*	*1.80*	*1 85*	*2 21*

Soft Steel Bars at Pittsburgh, Cents a Pound

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	2.90	2.70	2.75	2.35	1.50	2.04	2.40	2.10	2 00	1.98	1.81	1.90	1.89	1.64	1.50	1.60	1.75	1 80	1.85	2 20
Feb	2.90	2.70	3.00	2.15	1.39	2.20	2.40	2.10	2.00	1.90	1 85	1.90	1.85	1.65	1.50	1.60	1.75	1.80	1.85	2 20
March	2.90	2.61	3.63	2.00	1.39	2.39	2.40	2.10	2.00	1.90	1.85	1.90	1.85	1.65	1.52	1.60	1.75	1.80	1.85	2 40
April	2.90	2.35	3.75	2 05	1.50	2.50	2.29	2.05	2.00	1.89	1.85	1.95	1.79	1.65	1.60	1.60	1.79	1.80	1.85	2 45
May	2.90	2.35	3.63	2.10	1.58	2.40	2.24	2.00	1.95	1.85	1.85	1.95	1.75	1.65	1.60	1.60	1.90	1.80	1.85	2 45
June	2.90	2.35	3.50	2.05	1.70	2.40	2.20	2.00	2.00	1.81	1.85	1.95	1.73	1.65	1.60	1.60	1.90	1.80	1.85	2 45
July	2.90	2.35	3.50	1.84	1.70	2.40	2 15	2.00	2.00	1.80	1.85	1 95	1.65	1.63	1 60	1.60	1.82	1.80	1.95	2 45
Aug	2.90	2.35	3.25	1.74	1.88	2.40	2.13	1.95	2.00	1.80	1.90	1.95	1.64	1.60	1.60	1.60	1.80	1.80	1.95	2 45
Sept	2.90	2.35	3.25	1.63	2.00	2.40	2.04	1.92	2.00	1.78	1.90	1.94	1.61	1.60	1.60	1 60	1.80	1.80	1.97	2 45
Oct	2.90	2 39	3.13	1.55	2.00	2.40	2.00	2.00	2.00	1.75	1.91	1.90	1.60	1.60	1.60	1.75	1.80	1.85	2.05	2 45
Nov	2.90	2.69	2.87	1.50	2.00	2.40	2.03	2.00	2.00	1.77	1.94	1.90	1.60	1.60	1.60	1.75	1.80	1 85	2.05	2 45
Dec	2.80	2.75	2.35	1.50	2.00	2.40	2.10	2.00	2.00	1.80	1 90	1.90	1.60	1.58	1.60	1 75	1.80	1 85	2.05	2 45
Aver	*2.89*	*2.50*	*3.22*	*1.87*	*1.72*	*2.36*	*2.20*	*2.02*	*2.00*	*1.84*	*1.87*	*1.92*	*1.71*	*1.63*	*1.57*	*1.64*	*1.81*	*1.81*	*1.95*	*2.40*

Cold-Finished Steel Bars at Pittsburgh, Cents a Pound

	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	2.20	2.15	2.08	2.00	1.70	2.10	2.10	2.10	2.55
Feb	2.20	2.10	2.10	2 00	1.70	2.10	2 10	2.10	2.55
March	2.20	2.10	2.10	2 00	1.70	2.10	2 10	2.10	2.83
April	2.30	2.10	2.10	2.00	1.70	2 10	2.01	2.10	2.90
May	2.30	2 10	2.10	1.82	1.70	2.10	1.95	2.10	2.90
June	2.30	2 10	2.10	1.70	1.70	2 10	1.95	2.10	2.90
July	2.30	2 10	2.10	1.70	1.70	2.10	1.95	2.25	2.90
Aug	2 30	2 10	2.10	1.70	1.70	2.10	1.95	2.25	2.90
Sept	2 30	2 10	2.10	1.70	1.95	2.10	1.95	2.25	2.90
Oct	2.30	2 10	2 10	1.70	1.95	2 10	1.95	2.35	2.90
Nov	2.30	2.00	2.10	1.70	1.95	2.10	1.95	2.35	2.90
Dec	2.30	2.00	2.02	1.70	2.10	2 10	1 95	2.35	2.90
Aver	*2.28*	*2.09*	*2.09*	*1.81*	*1.80*	*2.10*	*1.99*	*2.20*	*2.84*

Large Structural Rivets at Pittsburgh, Dollars a CWT

	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	$2.90	$3 10	$2.75	$2.25	$2 25	$2.75	$2 90	$2.90	$3 25
Feb	2 90	3 10	2.75	2.25	2 25	2 75	2 90	2.90	3.25
March	2 90	3 10	2.75	2.25	2 25	2 75	2 90	2.90	3.53
April	3 06	3 10	2 75	2.25	2.25	2.88	2.90	2.90	3.60
May	3 10	2.95	2.75	2.25	2 25	3 00	2 90	2.90	3.60
June	3.10	2.90	2.75	2.25	2.38	3.00	2 90	2.90	3.60
July	3.10	2.90	2.75	2.25	2.50	2 92	2.90	3.05	3.60
Aug	3 10	2.79	2.75	2.25	2.50	2 90	2.90	3.05	3.60
Sept	3.10	2 75	2 55	2.25	2.50	2 90	2.90	3.05	3.60
Oct	3.10	2.75	2.25	2.25	2.65	2.90	2.90	3.05	3.60
Nov	3.10	2.75	2.25	2.25	2.75	2.90	2.90	3.05	3.60
Dec	3.10	2.75	2.25	2.25	2.75	2.90	2 90	3.21	3.60
Aver	*3.05*	*2.91*	*2.61*	*2.25*	*2.44*	*2 88*	*2 90*	*2.99*	*3.54*

No. 24 Gage Galvanized Sheets, at Pittsburgh, Cents a Pound

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	6.25	6.05	5.33	5.70	4.00	4.35	4.98	4.75	4 60	3.78	3.65	3.60	3.33	2.90	2 80	2.68	2.85	3.10	3.10	3.40
Feb	6.25	6.05	6.50	5.56	4.00	4.54	5.00	4.75	4.53	3.71	3.65	3.60	3.30	2.90	2.75	2.50	2.85	3.10	3.10	3.40
March	6.25	5.96	7.00	5.05	4.00	4.93	4.93	4.62	4.50	3.65	3.65	3.60	3.30	2.90	2.85	2.60	2.85	3.10	3.10	3.72
April	6.25	5.70	7.00	4.88	4.11	5.25	4.88	4.45	4.50	3.63	3.65	3.60	3.30	2.84	2.85	2.63	2.95	3.10	3.10	3.80
May	6.25	5.70	7.00	5.00	4.15	5.20	4.80	4.29	4.43	3.72	3.58	3.60	3.23	2.80	2.85	2.70	3.25	3.10	3.10	3.80
June	6.25	5.70	7.00	4.88	4.15	5.00	4.76	4.21	4.28	3.85	3.50	3.60	3.19	2.74	2.85	2.70	3.25	3.10	3.10	3.80
July	6.25	5.70	8.25	4.31	4.15	5.00	4.56	4.19	4.24	3.85	3.46	3.60	3.13	2 90	2.85	2.85	3.13	3.10	3.20	3.80
Aug	6.25	5.70	9.00	3.90	4.23	5.00	5.55	4.20	4.23	3.85	3.40	3.50	3.05	2.90	2.81	2.85	3.10	3.10	3.20	3.80
Sept	6.25	5.70	8.88	3.81	4.35	5.00	4.60	4.20	*3.83	3.85	3.40	3.50	3.00	2.90	2.75	2.85	3.10	3.10	3.20	3.80
Oct	6.25	5.70	8.18	4.00	4.50	5.00	4.60	4.23	3.85	3.76	3.50	3.50	2.99	2.90	2.85	2.85	3.10	3.10	3.20	3.80
Nov	6.25	5.70	7.04	3.86	4.43	4.93	4.60	4.50	3.85	3.66	3.50	3.48	2.95	2.90	2.85	2.85	3.10	3.10	3.20	3.80
Dec	6.15	5.70	5.70	4.00	4.35	4.89	4.72	4.60	3.85	3.63	3.58	3.40	2.92	2.86	2.85	2.85	3.10	3.10	3.40	3.80
Aver	*6.24*	*5.78*	*7.24*	*4.58*	*4.20*	*4.98*	*4.75*	*4.42*	*3.89*	*3.75*	*3.54*	*3.55*	*3.14*	*2.87*	*2.83*	*2.74*	*3.05*	*3.10*	*3.17*	*3.73*

*No. 24 gage was made the base in September, 1926. Quotations prior to that time are for No. 28 gage, for which there is now an extra of 50c. per 100 lb.

No. 24 Hot-Rolled Annealed Sheets, at Pittsburgh, Cents a Pound

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	5.00	4.70	4.48	4.35	3.00	3.35	3.83	3.60	3.35	2.91	2.80	2.85	2.65	2.35	2.22	2.02	2.25	2.40	2.40	2.80
Feb	5.00	4.70	5.00	4.21	3.00	3.46	3.85	3.50	3.27	2.80	2.90	2.85	2.61	2.35	2.15	2.00	2.25	2.40	2.40	2.80
March	5.00	4.61	5.50	3.88	3.00	3.71	3.78	3.44	3.25	2.75	2.89	2.85	2.65	2.31	2.19	2.00	2.25	2.40	2.40	3.08
April	5.00	4.35	5.50	3.88	3.11	4.00	3.71	3.35	3.25	2.74	2.77	2.85	2.55	2.25	2.20	2.00	2.35	2.40	2.40	3.15
May	5.00	4.35	5.50	4.00	3.15	3.88	3.60	3.20	3.17	2.86	2.71	2.85	2.55	2.15	2.20	2.04	2.65	2.40	2.40	3.15
June	5.00	4.35	5.50	3.80	3.15	3.85	3.53	3.15	3.10	3.00	2.65	2.85	2.55	2.20	2.20	2.10	2.65	2.40	2.40	3.15
July	5.00	4.35	6.75	3.31	3.15	3.81	3.46	3.13	3.10	3.00	2.62	2.85	2.49	2.40	2.20	2.25	2.47	2.40	2.50	3.15
Aug	5.00	4.34	7.50	2.90	3.23	3.75	3.45	3.15	3.10	3.00	2.65	2.85	2.44	2.40	2.16	2.25	2.40	2.40	2.50	3.15
Sept	5.00	4.35	7.38	2.81	3.35	3.75	3.50	3.14	*2.90	3.00	2.65	2.85	2.42	2.40	2.10	2.25	2.40	2.40	2.50	3.15
Oct	5.05	4.35	6.69	3.00	3.47	3.75	3.50	3.11	2.97	2.90	2.75	2.77	2.36	2.40	2.17	2.25	2.40	2.40	2.60	3.15
Nov	5.00	4.35	5.77	2.86	3.35	3.75	3.50	3.25	3.00	2.78	2.75	2.75	2.35	2.40	2.10	2.25	2.40	2.40	2.60	3.15
Dec	4.85	4.35	4.35	3.00	3.35	3.75	3.54	3.33	3.00	2.77	2.83	2.75	2.35	2.35	2.10	2.25	2.40	2.40	2.80	3.15
Aver	*4.99*	*4.43*	*5.83*	*3.50*	*3.19*	*3.73*	*3.60*	*3.28*	*2.95*	*2.88*	*2.75*	*2.83*	*2.50*	*2.33*	*2.17*	*2.14*	*2.41*	*2.40*	*2.49*	*3.09*

*No. 24 gage was made the base in September, 1926; prices prior to that time are for No. 28 gage.

Hot-Rolled Sheets, No. 10 Gage, at Pittsburgh, Cents a Pound

	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	2.25	2.52	3.00	2.70	2.50	2.25	2.10	2.10	2.10	1.90	1.75	1.62	1.75	1.85	1.85	2.15
Feb	2.25	2.64	3.00	2.70	2.50	2.20	2.10	2.10	2.10	1.90	1.75	1.60	1.75	1.85	1.85	2.15
March	2.25	2.95	2.93	2.69	2.50	2.20	2.10	2.10	2.10	1.90	1.71	1.55	1.75	1.85	1.85	2.34
April	2.36	3.25	2.86	2.53	2.43	2.18	2.08	2.10	2.06	1.85	1.70	1.55	1.81	1.85	1.85	2.40
May	2.40	3.20	2.80	2.40	2.40	2.22	2.00	2.13	2.00	1 85	1.70	1.44	2.00	1.85	1.85	2.40
June	2.40	3.00	2.76	2.31	2.32	2.25	2.00	2.20	2.00	1.85	1.70	1.50	2.00	1.85	1.85	2.40
July	2.40	3.00	2.68	2.30	2 30	2.25	2.00	2.14	2.00	1.85	1 70	1.65	1.88	1.85	1.95	2.40
Aug	2.44	3.00	2.63	2.30	2.30	2 25	2.00	2.10	1.93	1.85	1.70	1.65	1.85	1.85	1.95	2.40
Sept	2.44	3.00	2.69	2.25	2.30	2.25	2.00	2.10	1.90	1.85	1.70	1.68	1 85	1.85	1.95	2.40
Oct	2.60	3.00	2.70	2 26	2.30	2.14	2.00	2.10	1.90	1.85	1.70	1.75	1.85	1.85	1.95	2.40
Nov	2.55	3.00	2.70	2 40	2.30	2.10	2.00	2.10	1.90	1.85	1.70	1.75	1.85	1.85	1.95	2.40
Dec	2.50	3.00	2.70	2.50	2.30	2.10	2.08	2.18	1.90	1.80	1.70	1.75	1.85	1 85	2.15	2.40
Aver	*2.41*	*2.96*	*2.79*	*2.45*	*2.37*	*2.20*	*2.04*	*2.12*	*1.99*	*1.86*	*1.71*	*1.62*	*1.85*	*1.85*	*1.98*	*2.35*

Automobile Body and Light Cold-Rolled Sheets, No. 20 Gage, at Pittsburgh, Cents a Pound

Automobile Body Classification Dropped in November, 1932. Quotations for 1933-36 are on Light Cold-Rolled Sheets

	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	4.35	4.70	5.35	4.75	4.50	4.18	4.00	4.10	3.90	3.30	2.90	2.35	2.75	2.95	2.95	3.25
Feb	4.35	4.78	5.35	4.68	4.43	4.15	4.08	4.10	3.90	3.90	2.80	2.25	2.75	2.95	2.95	3.25
March	4.35	5.00	5.35	4.46	4.40	4.15	4.15	4.10	3.88	3.24	2.86	2.30	2.75	2.95	2.95	3.49
April	4.40	5.00	5.25	4.40	4.33	4.15	4.04	4.10	3.80	3.10	2.90	2.30	2.85	2.95	2.95	3.55
May	4.45	5.35	5.10	4.40	4.29	4.15	4.00	4.10	3.75	3.03	2.89	2.34	3.15	2.95	2.95	3.55
June	4.50	5.35	5.10	4 22	4.20	4.25	4.00	4 10	3.65	3 02	2.85	2.29	3.15	2.95	2.95	3.55
July	4.60	5.35	5.06	5.15	4.20	4.25	4.00	4.10	3.60	3.10	2.85	2.40	2.99	2.95	3.05	3.55
Aug	4.75	5.35	4.75	4.25	4.20	4.25	4.00	4.08	3.60	3.10	2.81	2.47	2.95	2.95	3.05	3.55
Sept	4.85	5.35	4.72	4 25	*4.25	4.25	4.00	4 00	3.50	3.10	2.75	2.75	2.95	2.95	3.05	3.55
Oct	4.85	5.35	4 60	4.29	4.25	4 15	4.00	4 00	3.45	3 10	2.65	2.75	2.95	2.95	3.05	3.55
Nov	4.85	5.35	4.60	4.40	4.25	4.12	4.00	4 00	3.38	3.10	2.63	2.75	2.95	2 95	3.05	3.55
Dec	4.70	5.25	4.75	4.50	4.25	4.00	4.08	3.98	3.30	3.02	2.65	2.75	2.95	2 95	3.25	3.55
Aver	*4.58*	*5.19*	*5.00*	*4.39*	*4.30*	*4.17*	*4.03*	*4.06*	*3.64*	*3 13*	*2.80*	*2.48*	*2.96*	*2.95*	*3.02*	*3.49*

*No. 22 gage prior to Sept. 1, 1926.

Tin Plate at Pittsburgh, Dollars a Base Box

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan	$7.75	$7.35	$7.00	$7.00	$4.75	$4.75	$5.50	$5.50	$5.50	$5.50	$5.25	$5.35	$5.25	$5.00	$4.75	$4.25	$5.25	$5.25	$5.25	$4.85
Feb	7.75	7.35	7.00	7.00	4.71	4.80	5.50	5.50	5.50	5.50	5.25	5.35	5.25	5.00	4.75	4.25	5.25	5.25	5.25	4.85
March	7.75	7.26	7.00	7.00	4.60	5 23	5.50	5.50	5.50	5.50	5.25	5.35	5.25	5.00	4.75	4.25	5.25	5.25	5.25	4.85
April	7.75	7.00	7.00	6.44	4.75	6.00	5.50	5.50	5.50	5.50	5.25	5.35	5.25	5.00	4.75	4.25	5.25	5.25	5.25	5.35
May	7.75	7.00	7.00	6.25	4.75	5.70	5.50	5.50	5.50	5.50	5.25	5.35	5.25	5.00	4.75	4.25	5.25	5.25	5.25	5.35
June	7.75	7.00	7.00	6.25	4.75	5.50	5.50	5.50	5.50	5.50	5.25	5.35	5.25	5.00	4.75	4.25	5.25	5.25	5 25	5.35
July	7.75	7.00	7.50	5.69	4.75	5.50	5.50	5.50	5.50	5.50	5.25	5.35	5.25	5.00	4.75	4.25	5.25	5.25	5.25	5.35
Aug	7.75	7.00	9.00	5.25	4.75	5.50	5 50	5.50	5.50	5.50	5.25	5.35	5.25	5.00	4.75	4.25	5.25	5.25	5.25	5.35
Sept	7.75	7.00	9.00	5.25	4.75	5.50	5.50	5.50	5.50	5.50	5.25	5.35	5.25	5.00	4.75	4.65	5.25	5.25	5.25	5.35
Oct	7.75	7.00	8.33	5.13	4.75	5.50	5.50	5.50	5.50	5.50	5.25	5.35	5.00	4 75	4.75	4.65	5.25	5.25	5.25	5.35
Nov	7.75	7.00	7.50	4.75	4.75	5.50	5.50	5.50	5.50	5.50	5.25	5.35	5.00	4.75	4.55	4.65	5.25	5 25	5.25	5.35
Dec	7.55	7.00	7.00	4.73	4.75	5.50	5.50	5.50	5.50	5.25	5.25	5.35	5.00	4.75	4.25	5.25	5.25	5 25	5.25	5.35
Aver	*7.73*	*7.08*	*7.53*	*5.90*	*4.73*	*5.42*	*5.50*	*5.50*	*5.50*	*5.48*	*5.25*	*5.35*	*5.19*	*4.94*	*4.69*	*4.43*	*5.25*	*5.25*	*5.25*	*5.22*

Hot-Rolled Strip Steel, at Pittsburgh, Cents a Pound

(Prices quoted only on strip wider than 6-in. prior to June 1, 1932.)

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	3.45	3.30	2.00	2.75	3.00	2.25	2.30	2.34	2.01	1.80	1.80	1.55	1.41	1.45	1.75	1.85	1.85	2.15
Feb.	4.63	3.11	1.84	2.86	3.00	2.35	2.30	2.21	2.08	1.80	1.80	1.55	1.40	1.45	1.75	1.85	1.85	2.15
March	5.00	2.93	1.81	3.18	2.93	2.40	2.30	2.30	2.10	1.80	1.79	1.55	1.40	1.45	1.75	1.85	1.85	2.35
April	5.25	2.76	1.98	3.30	2.75	2.40	2.30	2.30	2.10	1.90	1.70	1.55	1.40	1.45	1.81	1.85	1.85	2.40
May	5.50	2.53	2.20	2.30	2.75	2.20	2.30	2.30	1.96	1.90	1.70	1.55	1.40	1.49	2.00	1.85	1.85	2.40
June	5.50	2.50	2.40	3.23	2.50	2.20	2.30	2.30	1.85	1.90	1.69	1.55	1.41	1.55	2.00	1.85	1.85	2.40
July	5.50	2.46	2.50	3.00	2.50	2.20	2.30	2.30	1.85	1.90	1.65	1.55	1.45	1.60	1.88	1.85	1.95	2.40
Aug.	5.50	2.23	2.60	3.00	2.35	2.20	2.30	2.30	1.85	1.90	1.65	1.55	1.45	1.64	1.85	1.85	1.95	2.40
Sept.	5.50	2.00	2.75	3.00	2.25	2.20	2.30	2.30	1.85	1.90	1.65	1.55	1.45	1.68	1.85	1.85	1.95	2.40
Oct.	5.25	2.00	2.90	3.00	2.25	2.23	2.30	2.19	1.85	1.90	1.60	1.54	1.45	1.75	1.85	1.85	1.95	2.40
Nov.	4.70	2.00	2.83	3.00	2.25	2.30	2.30	2.10	1.88	1.90	1.58	1.50	1.45	1.75	1.85	1.85	1.95	2.40
Dec.	3.65	2.00	2.75	2.88	2.25	2.30	2.30	2.03	1.80	1.90	1.55	1.49	1.45	1.75	1.85	1.85	2.11	2.40
Aver.	*4.95*	*2.49*	*2.38*	*3.04*	*2.57*	*2.27*	*2.30*	*2.26*	*1.93*	*1.88*	*1.68*	*1.54*	*1.43*	*1.58*	*1.86*	*1.85*	*1.91*	*2.35*

Cold-Rolled Strip Steel, at Pittsburgh, Cents a Pound

	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	6.25	6.00	6.25	3.50	4.50	5.00	4.00	3.90	2.95	3.00	2.85	2.65	2.25	1.92	1.88	2.40	2.60	2.60	2.85
Feb.	6.25	7.00	6.06	3.50	4.69	4.75	4.00	3.90	2.80	3.00	2.85	2.65	2.25	1.90	1.80	2.40	2.60	2.60	2.85
March	6.10	7.00	5.83	3.50	5.00	4.75	4.00	3.90	2.92	3.00	2.80	2.60	2.25	1.96	1.80	2.40	2.60	2.60	3.13
April	5.65	7.75	5.54	3.61	5.25	4.75	4.00	3.79	3.00	3.00	2.75	2.55	2.23	2.00	1.80	2.50	2.60	2.60	3.20
May	5.65	8.50	4.98	3.71	5.25	4.50	3.94	3.75	3.00	3.00	2.75	2.50	2.15	2.00	1.88	2.80	2.60	2.60	3.20
June	5.65	8.50	4.88	4.00	5.19	4.50	3.53	3.72	3.19	3.00	2.75	2.45	2.15	2.00	2.00	2.80	2.60	2.60	3.20
July	5.65	8.50	4.25	4.00	5.00	4.30	3.63	3.60	3.25	2.92	2.75	2.45	2.15	2.00	2.19	2.64	2.60	2.60	3.20
Aug.	5.65	8.50	3.96	4.10	5.00	4.13	3.75	3.60	3.25	2.90	2.75	2.35	2.15	2.00	2.25	2.60	2.60	2.60	3.20
Sept.	5.65	8.50	3.78	4.25	5.00	4.00	3.75	3.50	3.25	2.72	2.75	2.35	2.15	1.92	2.29	2.60	2.60	2.60	3.20
Oct.	5.65	8.25	3.75	4.50	5.00	4.00	3.75	3.25	3.00	2.75	2.75	2.35	2.13	1.90	2.40	2.60	2.60	2.60	3.20
Nov.	5.65	8.00	3.75	4.50	4.98	4.00	3.90	3.25	3.00	2.85	2.75	2.33	2.05	2.00	2.40	2.60	2.60	2.60	3.20
Dec.	5.93	6.63	3.75	4.50	4.91	4.00	3.90	3.00	3.00	2.85	2.75	2.25	2.03	2.00	2.40	2.60	2.60	2.80	3.20
Aver.	*5.81*	*7.76*	*4.73*	*3.97*	*4.98*	*4.39*	*3.85*	*3.60*	*3.05*	*2.92*	*2.77*	*2.46*	*2.16*	*1.97*	*2.09*	*2.58*	*2.60*	*2.62*	*3.14*

Wire Nails at Pittsburgh, Keg of 100 Lb.

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$3.50	$3.50	$4.50	$3.25	$2.50	$2.70	$3.00	$2.85	$2.65	$2.64	$2.54	$2.65	$2.33	$1.90	$1.95	$1.86	$2.35	$2.60	$2.40	$2.25
Feb.	3.50	3.50	4.50	3.21	2.40	2.78	3.00	2.85	2.65	2.56	2.63	2.65	2.25	1.90	1.95	1.83	2.35	2.60	2.25	2.31
March	3.50	3.44	4.00	3.02	2.40	2.83	3.00	2.85	2.65	2.55	2.65	2.65	2.25	1.90	1.95	1.85	2.35	2.60	2.10	2.70
April	3.50	3.25	4.00	3.13	2.40	2.93	3.00	2.80	2.65	2.55	2.65	2.65	2.16	1.90	1.95	1.85	2.41	2.60	2.10	2.75
May	3.50	3.25	4.00	3.05	2.40	3.00	2.93	2.75	2.65	2.50	2.55	2.65	2.15	1.85	1.95	1.85	2.60	2.60	2.10	2.75
June	3.50	3.25	4.00	3.00	2.40	3.00	2.90	2.68	2.65	2.50	2.55	2.65	2.13	1.80	1.95	1.85	2.60	2.60	2.10	2.75
July	3.50	3.25	4.00	2.81	2.40	3.00	2.88	2.65	2.65	2.53	2.55	2.64	2.05	1.80	1.95	2.04	2.60	2.60	2.10	2.75
Aug.	3.50	3.25	4.25	2.75	2.48	3.00	2.81	2.65	2.65	2.55	2.55	2.55	2.04	1.88	1.95	2.10	2.60	2.55	2.10	2.75
Sept.	3.50	3.25	4.25	2.86	2.63	3.00	2.78	2.65	2.65	2.55	2.55	2.50	2.00	1.90	1.95	2.10	2.60	2.40	1.97	2.75
Oct.	3.50	3.31	4.25	2.90	2.70	3.00	2.75	2.63	2.65	2.54	2.55	2.43	1.99	1.90	1.95	2.10	2.60	2.40	2.05	2.75
Nov.	3.50	3.50	4.05	2.84	2.70	3.00	2.75	2.65	2.65	2.50	2.55	2.40	1.93	1.90	1.95	2.10	2.60	2.40	2.05	2.75
Dec.	3.50	4.12	3.25	2.69	2.70	3.00	2.85	2.65	2.65	2.50	2.63	2.40	1.90	1.93	1.95	2.35	2.60	2.40	2.25	2.75
Aver.	*3.50*	*3.41*	*4.09*	*2.96*	*2.51*	*2.94*	*2.89*	*2.72*	*2.65*	*2.54*	*2.58*	*2.57*	*2.10*	*1.88*	*1.95*	*1.99*	*2.52*	*2.40*	*2.13*	*2.67*

Plain Wire, Base, at Pittsburgh, Cents a Pound

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	3.25	3.25	3.25	3.25	2.25	2.45	2.75	2.60	2.50	2.49	2.40	2.50	2.40	2.20	2.20	2.16	2.20	2.30	2.30	2.60
Feb.	3.25	3.25	3.50	3.13	2.20	2.63	2.75	2.60	2.50	2.41	2.48	2.50	2.40	2.20	2.20	2.10	2.20	2.30	2.30	2.60
March	3.25	3.19	3.50	3.00	2.25	2.65	2.75	2.60	2.50	2.40	2.50	2.50	2.40	2.20	2.20	2.10	2.20	2.30	2.30	2.84
April	3.25	3.00	3.50	3.00	2.25	2.68	2.75	2.50	2.50	2.40	2.50	2.50	2.38	2.20	2.20	2.10	2.23	2.30	2.40	2.90
May	3.25	3.00	3.50	3.00	2.25	2.75	2.68	2.50	2.50	2.40	2.50	2.50	2.30	2.20	2.20	2.10	2.30	2.30	2.40	2.90
June	3.25	3.00	3.50	2.75	2.25	2.75	2.65	2.49	2.50	2.40	2.50	2.50	2.30	2.20	2.20	2.10	2.30	2.30	2.40	2.90
July	3.25	3.00	3.50	2.56	2.25	2.75	2.63	2.50	2.50	2.40	2.42	2.50	2.30	2.20	2.20	2.10	2.30	2.30	2.40	2.90
Aug.	3.25	3.00	3.69	2.50	2.29	2.75	2.56	2.50	2.50	2.40	2.40	2.43	2.30	2.20	2.20	2.10	2.30	2.30	2.40	2.90
Sept.	3.25	3.00	3.75	2.58	2.39	2.75	2.53	2.50	2.50	2.40	2.40	2.40	2.30	2.20	2.20	2.10	2.30	2.30	2.40	2.90
Oct.	3.25	3.17	3.75	2.60	2.45	2.75	2.50	2.50	2.50	2.40	2.40	2.40	2.30	2.20	2.20	2.10	2.30	2.30	2.50	2.90
Nov.	3.25	3.29	3.65	2.56	2.45	2.75	2.50	2.50	2.50	2.40	2.40	2.40	2.30	2.20	2.20	2.10	2.30	2.30	2.50	2.90
Dec.	3.25	3.21	3.25	2.44	2.45	2.75	2.60	2.50	2.50	2.40	2.48	2.40	2.22	2.20	2.20	2.20	2.30	2.30	2.60	2.90
Aver.	*3.25*	*3.11*	*3.53*	*2.78*	*2.31*	*2.70*	*2.64*	*2.52*	*2.50*	*2.41*	*2.45*	*2.46*	*2.33*	*2.20*	*2.20*	*2.11*	*2.27*	*2.30*	*2.41*	*2.84*

Wrought Iron Pipe at Pittsburgh, Net Ton

Computed from list discounts, for carload lots; price for base size pipe, 1½ in.; 1½ and 2 in. prior to Oct. 1, 1932.

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$135.06	$100.96	$122.56	$131.10	$131.10	$127.82	$127.82	$127.82	$118.56	$118.56	$118.56	$118.56	$120 00	$113.00	$113.00	$113.00	$119.75
Feb.	136 16	100.96	127.82	131.10	131 10	127 82	127.82	127.82	118.56	118.56	118.56	116.71	120.00	113 00	113.00	113.00	122.00
March	136.16	100.96	127.82	131.10	127.82	127.82	127.82	127.82	118.56	118.56	118.56	114.85	120.00	113.00	113.00	113.00	122.00
April	125.66	100.96	129.02	131.10	127.82	127.82	127.82	127.82	118.56	118.56	118.56	114.85	114.75	113.00	113.00	113.00	122.00
May	117.63	100.96	131.10	131.10	127.82	127.82	127.82	127.82	118 56	118.56	118.56	114.85	113.00	113.00	113.00	113.00	127.00
June	117.63	100.96	131.10	131.10	127.82	127 82	127.82	127.82	118.56	118.56	118.56	114.85	113.00	113.00	113.00	113.00	132.00
July	111.65	100.96	131.10	131.10	127.82	127.82	127.82	127.82	118.56	118.56	118.56	114.85	113.00	113.00	113 00	113.00	132.00
Aug.	110.22	105.74	131.10	131.10	127.82	127.82	127.82	127.82	118.56	118.56	118.56	114.85	113.00	113.00	113.00	113.00	132.00
Sept.	105.59	116.33	131.10	131.10	127.82	127 82	127.82	127.82	118.56	118.56	118.56	116.14	113.00	113.00	113.00	113.00	132.00
Oct.	100.96	120.41	131.10	131.10	127.82	127.82	127.82	127.82	118.56	118.56	118.56	120.00	113.00	113.00	113.00	113.00	132.00
Nov.	100.96	120.41	131.10	131.10	127.82	127.82	127 82	127.82	118.56	118.56	118.56	120.00	113.00	113.00	113.00	113.00	132.00
Dec.	100.96	120 41	131.10	131.10	127.82	127.82	127.82	127.82	118.56	118.56	118.56	120.00	113.00	113.00	113 00	113.00	132.00
Aver.	*116.55*	*107.50*	*129.67*	*131.10*	*128.37*	*127.82*	*127.82*	*127.82*	*118.56*	*118.56*	*118 56*	*116.71*	*114.90*	*113.00*	*113.00*	*113.00*	*128.06*

Finished Iron and Steel at Chicago

Soft Steel Bars at Chicago, Cents a Pound

	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	2.00	1.99	1.71	1.68	1.70	1.80	1.85	1.90	2.25
Feb.	2.01	1.95	1.72	1.65	1.70	1.80	1.85	1.90	2.25
March	2.05	1.95	1.70	1.68	1.70	1.80	1.85	1.90	2.45
April	2.05	1.91	1.75	1.70	1.70	1.84	1.85	1.90	2.50
May	2.05	1.85	1.70	1.70	1.70	1.95	1.85	1.90	2.50
June	2.05	1.83	1.70	1.70	1.70	1.95	1.85	1.90	2.50
July	2.05	1.75	1.70	1.70	1.70	1.87	1.85	2.00	2.50
Aug.	2.05	1.75	1.70	1.70	1.69	1.85	1.85	2.00	2.50
Sept.	2.05	1.71	1.70	1.70	1.65	1.85	1.85	2.00	2.50
Oct.	2.03	1.70	1.70	1.70	1.80	1.85	1.90	2.10	2.50
Nov.	2.00	1.70	1.70	1.70	1.80	1.85	1.90	2.10	2.50
Dec.	2.00	1.70	1.60	1.70	1.80	1.85	1.90	2.10	2.50
Aver.	*2.03*	*1.82*	*1.70*	*1.69*	*1.72*	*1.86*	*1.86*	*1.97*	*2.45*

Structural Shapes at Chicago, Cents a Pound

	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	2.00	1.99	1.71	1.68	1.70	1.75	1.85	1.85	2.10
Feb.	2.01	1.95	1.72	1.65	1.70	1.75	1.85	1.85	2.10
March	2.05	1.94	1.70	1.68	1.70	1.75	1.85	1.85	2.25
April	2.05	1.90	1.75	1.70	1.70	1.75	1.85	1.85	2.30
May	2.05	1.83	1.70	1.70	1.70	1.90	1.85	1.85	2.30
June	2.05	1.79	1.70	1.70	1.70	1.90	1.85	1.85	2.30
July	2.05	1.75	1.70	1.70	1.70	1.86	1.85	1.95	2.30
Aug.	2.05	1.75	1.70	1.70	1.69	1.85	1.85	1.95	2.30
Sept.	2.05	1.71	1.70	1.70	1.65	1.85	1.85	1.95	2.30
Oct.	2.03	1.70	1.70	1.70	1.75	1.85	1.85	1.95	2.30
Nov.	2.00	1.70	1.70	1.70	1.75	1.85	1.85	1.95	2.30
Dec.	2.00	1.70	1.60	1.70	1.75	1.85	1.85	1.95	2.30
Aver.	*2.03*	*1.81*	*1.70*	*1.69*	*1.71*	*1.85*	*1.85*	*1.90*	*2.26*

Rail Steel Bars at Chicago District Mill, Cents a Pound

	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	1.90	1.88	1.60	1.50	1.50	1.70	1.75	1.75	2.10
Feb.	1.95	1.80	1.60	1.50	1.50	1.70	1.75	1.75	2.10
March	1.95	1.85	1.60	1.50	1.50	1.70	1.75	1.75	2.30
April	1.95	1.81	1.60	1.50	1.50	1.74	1.75	1.75	2.35
May	1.95	1.80	1.60	1.50	1.50	1.85	1.75	1.75	2.35
June	1.95	1.75	1.60	1.50	1.50	1.86	1.75	1.75	2.35
July	1.95	1.75	1.60	1.50	1.50	1.79	1.75	1.85	2.35
Aug.	1.95	1.65	1.60	1.50	1.51	1.75	1.75	1.85	2.35
Sept.	1.95	1.65	1.60	1.50	1.55	1.75	1.75	1.85	2.35
Oct.	1.95	1.65	1.54	1.50	1.70	1.75	1.75	1.95	2.35
Nov.	1.94	1.64	1.50	1.50	1.70	1.75	1.75	1.95	2.25
Dec.	1.90	1.60	1.50	1.50	1.70	1.75	1.75	1.95	2.25
Aver.	*1.94*	*1.74*	*1.58*	*1.50*	*1.56*	*1.76*	*1.75*	*1.82*	*2.30*

Common Bar Iron at Chicago, Cents a Pound

	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	2.00	1.98	1.71	1.68	1.60	1.60	1.80	1.80	2.15
Feb.	2.00	1.95	1.73	1.70	1.60	1.60	1.80	1.80	2.15
March	2.04	1.95	1.70	1.70	1.60	1.60	1.80	1.80	2.35
April	2.05	1.92	1.74	1.70	1.60	1.60	1.80	1.80	2.40
May	2.05	1.90	1.70	1.66	1.60	1.69	1.80	1.80	2.40
June	2.05	1.90	1.70	1.65	1.60	1.85	1.80	1.80	2.40
July	2.05	1.90	1.70	1.65	1.60	1.84	1.80	1.80	2.40
Aug.	2.05	1.75	1.70	1.62	1.60	1.80	1.80	1.80	2.40
Sept.	2.05	1.74	1.70	1.60	1.60	1.80	1.80	1.80	2.40
Oct.	2.04	1.70	1.70	1.60	1.60	1.80	1.80	1.80	2.40
Nov.	2.00	1.70	1.70	1.60	1.60	1.80	1.80	1.80	2.40
Dec.	2.00	1.70	1.60	1.60	1.60	1.80	1.80	1.80	2.40
Aver.	*2.03*	*1.84*	*1.70*	*1.65*	*1.60*	*1.76*	*1.80*	*1.80*	*2.35*

No. 24 Gage Hot-Rolled Annealed Sheets at Chicago District Mills, Cents a Pound

	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	3.00	2.85	2.45	2.35	2.12	2.35	2.50	2.50	2.90
Feb.	3.00	2.80	2.45	2.25	2.00	2.35	2.50	2.50	2.90
March	3.10	2.80	2.41	2.29	2.10	2.35	2.50	2.50	3.18
April	3.10	2.70	2.35	2.30	2.10	2.45	2.50	2.50	3.25
May	3.10	2.70	2.35	2.30	2.14	2.75	2.50	2.50	3.25
June	3.10	2.70	2.35	2.30	2.20	2.75	2.50	2.50	3.25
July	3.10	2.69	2.50	2.30	2.35	2.57	2.50	2.60	3.25
Aug.	3.05	2.55	2.50	2.30	2.35	2.50	2.50	2.60	3.25
Sept.	3.00	2.52	2.50	2.26	2.35	2.50	2.50	2.60	3.25
Oct.	3.00	2.53	2.50	2.28	2.35	2.50	2.50	2.70	3.25
Nov.	2.88	2.45	2.50	2.20	2.35	2.50	2.50	2.70	3.25
Dec.	2.80	2.45	2.45	2.20	2.35	2.50	2.50	2.90	3.25
Aver.	*3.02*	*2.65*	*2.44*	*2.28*	*2.23*	*2.51*	*2.50*	*2.59*	*3.19*

Galvanized Sheets at Chicago District Mill, Cents a Pound

	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	3.75	3.60	3.00	2.90	2.76	2.95	3.20	3.20	3.50
Feb.	3.75	3.40	3.00	2.87	2.55	2.95	3.20	3.20	3.50
March	3.85	3.40	3.00	2.93	2.70	2.95	3.20	3.20	3.82
April	3.85	3.40	2.90	2.95	2.73	3.05	3.20	3.20	3.90
May	3.85	3.33	2.90	2.95	2.86	3.35	3.20	3.20	3.90
June	3.85	3.29	2.87	2.95	2.95	3.35	3.20	3.20	3.90
July	3.85	3.25	3.00	2.95	2.95	3.23	3.20	3.30	3.90
Aug.	3.70	3.18	3.00	2.91	2.95	3.20	3.20	3.30	3.90
Sept.	3.65	3.10	3.00	2.85	2.95	3.20	3.20	3.30	3.90
Oct.	3.65	3.10	3.00	2.95	2.95	3.20	3.20	3.30	3.90
Nov.	3.60	3.10	3.00	2.95	2.95	3.20	3.20	3.30	3.90
Dec.	3.50	3.04	2.96	2.95	2.95	3.20	3.20	3.50	3.90
Aver.	*3.74*	*3.27*	*2.97*	*2.93*	*2.85*	*3.15*	*3.20*	*3.27*	*3.83*

Cast Iron Pipe, Net Ton

At New York, 6-in., and Larger

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$63.30	$47.30	$54.90	$61.60	$54.60	$50.60	$48.60	$37.25	$39.60	$36.10	$37.90	$30.20	$35.30	$43.00	$45.00	$45.20	$48.00
Feb.	63.30	47.30	56.50	61.60	54.60	50.60	48.60	37.25	39.35	38.60	37.90	29.70	35.30	43.00	45.00	45.20	48.00
March	63.30	47.68	57.75	61.60	53.00	50.60	47.20	37.25	38.60	38.75	37.90	28.40	35.30	43.00	45.00	45.20	51.00
April	63.30	48.80	58.50	61.60	52.60	50.60	47.35	36.25	37.40	39.50	35.40	8.20	35.30	43.00	45.00	45.20	53.00
May	62.05	49.60	58.50	61.60	50.85	50.60	45.80	37.60	35.85	39.90	34.15	28.20	35.30	43.00	45.00	45.20	53.00
June	54.30	50.80	61.35	61.60	50.60	50.60	44.42	37.60	35.10	39.90	33.70	28.20	38.30	44.00	45.15	45.20	53.00
July	52.30	53.50	62.30	60.60	50.60	50.60	42.75	37.60	33.20	39.30	32.90	28.73	38.30	45.00	45.20	45.90	53.00
Aug.	46.05	54.10	62.62	59.60	50.60	50.60	39.65	36.60	33.60	38.90	32.90	31.10	38.30	45.00	45.20	45.90	53.00
Sept.	46.30	54.50	63.60	56.60	50.60	49.85	37.25	35.60	33.60	38.90	32.90	31.30	38.30	45.00	45.20	45.90	53.00
Oct.	47.30	54.50	63.60	56.35	50.60	49.60	36.50	35.60	34.60	38.90	32.90	33.30	38.00	45.00	45.20	45.90	53.00
Nov.	47.30	54.50	63.60*	55.60	50.60	49.60	36.25	37.32	34.60	38.65	32.90	33.30	43.00	45.00	45.20	45.90	53.00
Dec.	47.30	54.75	63.60*	55.20	50.60	49.10	37.00	39.40	34.60	37.90	32.50	34.30	43.00	45.00	45.20	47.90	53.00
Aver.	*54.68*	*51.44*	*60.57*	*59.46*	*51.65*	*50.25*	*42.61*	*37.11*	*35.84*	*38.78*	*34.50*	*30.41*	*37.81*	*44.08*	*45.11*	*45.71*	*52.00*

*Concession of $2 to $3 a ton from this price to consumers willing to accept winter delivery.

At Chicago, 6-in. and Larger

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$64.10	$42.50	$51.80	$56.20	$48.70	$49.20	$44.32	$35.00	$43.33	$42.20	$13.00	$40.40	$40.00	$44.00	$47.00	$48.40	$50.00
Feb.	64.10	41.60	53.20	56.20	49.95	49.20	43.70	35.83	44.45	44.95	44.00	40.40	40.90	44.00	47.00	48.10	50.00
March	64.10	42.10	54.20	56.20	47.60	49.20	44.20	35.70	44.70	45.20	43.20	38.00	41.40	44.00	47.00	48.00	53.00
April	64.10	42.85	57.20	56.20	46.70	49.20	43.95	36.20	44.20	45.20	43.00	36.40	41.40	44.00	47.36	48.40	55.00
May	60.10	44.60	60.20	55.20	47.07	49.20	43.20	37.80	44.20	45.15	43.00	36.40	41.40	44.00	48.40	48.40	55.00
June	48.85	45.47	60.20	54.70	48.20	48.90	42.70	40.20	45.20	45.00	42.20	36.40	42.90	45.50	48.40	48.40	55.00
July	52.85	46.10	60.20	54.80	47.70	47.95	41.58	40.80	45.20	45.00	42.00	34.40	43.40	47.00	48.40	48.40	55.00
Aug.	43.20	46.40	60.20	53.45	49.20	48.30	37.40	42.20	45.20	44.75	42.00	35.20	43.40	47.00	48.40	48.40	55.00
Sept.	42.60	47.45	59.95	51.80	49.20	47.58	34.58	42.20	45.20	43.60	42.00	38.40	43.40	47.00	48.40	48.40	55.00
Oct.	42.60	51.20	57.40	49.70	49.20	47.20	34.20	43.00	43.70	44.00	41.60	38.40	43.00	47.00	48.40	48.40	55.00
Nov.	42.90	51.20	55.45	48.20	50.20	46.70	34.50	45.20	43.70	44.00	40.50	38.40	43.20	47.00	48.40	48.40	55.00
Dec.	43.10	51.20	55.20	47.60	50.20	46.70	35.08	43.10	43.70	43.60	40.20	38.40	44.00	47.00	48.40	50.00	55.00
Aver.	*52.72*	*46.06*	*57.10*	*53.35*	*48.66*	*48.32*	*39.95*	*39.77*	*44.39*	*44.39*	*42.23*	*37.60*	*42.37*	*45.63*	*47.30*	*48.47*	*54.00*

*Monthly Average Prices of Non-Ferrous Metals from Daily Quotations in THE IRON AGE

Electrolytic Copper at New York, Cents a Pound

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	12.95	13.55	14.52	12.46	14.73	13.84	12.99	13.85	16.59	17.75	9.79	7.12	4.75	7.92	8.75	9.00	12.41
Feb.	12.84	12.92	15.34	12.73	14.49	14.00	12.69	13.82	17.74	17.75	9.71	6.07	4.75	7.75	8.75	9.00	13.44
March	12.19	12.68	16.84	13.52	14.06	13.86	13.08	13.90	21.25	17.75	9.88	5.76	5.00	7.75	8.75	9.00	15.75
April	12.49	12.61	16.81	13.21	13.30	13.69	12.81	14.13	19.69	15.67	9.48	5.54	5.39	8.16	8.75	9.14	15.10
May	12.79	13.13	15.54	12.76	13.34	13.60	12.65	14.19	17.75	12.76	8.67	5.25	6.68	8.25	8.75	9.25	13.75
June	12.88	13.62	14.74	12.35	13.41	13.64	12.37	14.50	17.75	12.09	8.05	5.11	7.75	8.75	8.63	9.25	13.75
July	12.46	13.71	14.39	12.39	13.95	13.91	12.51	14.50	17.75	11.02	7.67	5.04	8.62	8.76	7.75	9.35	13.75
Aug.	11.70	13.74	13.87	13.26	14.48	14.19	13.00	14.50	17.75	10.65	7.26	5.15	8.75	8.75	7.92	9.50	13.75
Sept.	12.01	13.75	13.36	12.97	14.42	14.05	12.93	14.70	17.75	10.39	6.98	5.95	8.75	8.75	8.52	9.50	13.53
Oct.	12.67	13.66	12.58	12.96	14.29	13.88	12.98	15.16	17.75	9.60	6.75	5.72	7.97	8.75	8.94	9.54	11.81
Nov.	13.07	13.62	12.76	13.59	14.36	13.59	13.34	15.75	17.75	10.17	6.54	5.07	7.91	8.75	9.00	10.16	10.77
Dec.	13.55	14.00	12.88	14.23	13.82	13.31	13.79	15.84	17.75	10.29	6.60	4.78	7.87	8.75	9.00	10.73	9.98
Aver.	*12.63*	*13.42*	*14.47*	*13.04*	*14.05*	*13.80*	*12.93*	*14.57*	*18.11*	*12.99*	*8.11*	*5.55*	*7.02*	*8.41*	*8.63*	*9.45*	*13.15*

Spelter (Zinc) at New York, Cents a Pound

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	7.88	7.38	9.62	5.83	5.06	7.28	6.78	8.10	8.75	7.03	6.00	6.70	5.59	4.37	3.38	3.38	4.62	4.08	5.22	6.20
Feb.	7.99	6.70	9.14	5.36	4.85	7.58	7.11	7.86	8.16	7.04	5.90	6.70	5.53	4.36	3.19	3.04	4.73	4.06	5.23	6.80
March	7.64	6.52	8.93	5.20	5.00	8.19	6.85	7.68	7.69	7.06	5.98	6.80	5.30	4.30	3.16	3.37	4.72	4.25	5.27	7.75
April	7.01	6.51	8.63	5.24	5.25	7.65	6.49	7.35	7.36	6.69	6.11	7.04	5.19	4.06	3.10	3.68	4.72	4.38	5.27	7.70
May	7.32	6.46	8.08	5.28	5.45	6.99	6.13	7.30	7.16	6.43	6.37	6.98	4.98	3.66	2.90	4.17	4.71	4.60	5.27	7.10
June	8.01	6.93	7.92	4.95	5.69	6.40	6.14	7.35	7.47	6.57	6.50	7.00	4.79	3.75	3.16	4.70	4.59	4.67	5.26	7.10
July	8.69	7.90	8.18	4.77	6.12	6.43	6.25	7.60	7.76	6.58	6.55	7.10	4.66	4.25	2.92	5.24	4.68	4.70	5.16	7.27
Aug.	8.96	7.84	8.31	4.69	6.59	6.68	6.53	7.55	7.69	6.70	6.59	7.15	4.72	4.17	3.13	5.28	4.63	4.92	5.17	7.56
Sept.	9.60	7.57	7.82	4.74	6.91	6.81	6.54	8.12	7.76	6.56	6.60	7.15	4.62	4.09	3.68	5.08	4.43	5.04	5.22	7.54
Oct.	9.11	7.83	7.51	5.10	7.20	6.66	6.67	8.65	7.66	6.35	6.60	7.09	4.40	3.73	3.41	5.12	4.19	5.21	5.22	6.45
Nov.	8.70	8.14	6.84	5.18	7.48	6.70	7.14	9.04	7.56	6.09	6.62	6.63	4.63	3.55	3.46	4.87	4.08	5.23	5.35	5.98
Dec.	8.45	8.59	6.00	5.25	7.46	6.60	7.73	8.97	7.39	6.15	6.70	6.09	4.43	3.50	3.50	4.82	4.06	5.22	5.64	5.32
Aver.	*8.28*	*7.36*	*8.08*	*5.13*	*6.09*	*7.00*	*6.70*	*7.96*	*7.70*	*6.60*	*6.39*	*6.87*	*4.90*	*3.98*	*3.25*	*4.40*	*4.51*	*4.70*	*5.27*	*6.90*

Lead, at New York, Cents a Pound

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	6.87	5.56	8.67	5.00	4.70	7.85	8.31	10.26	9.25	7.59	6.50	6.65	6.25	4.80	3.75	3.00	4.00	3.69	4.50	6.00
Feb.	7.04	5.05	8.88	4.54	4.70	8.14	9.01	9.38	9.08	7.40	6.34	6.85	6.24	4.55	3.72	3.00	4.00	3.53	4.51	6.23
March	7.24	5.23	9.21	4.08	4.71	8.47	9.23	8.90	8.46	7.57	6.00	7.41	5.66	4.53	3.15	3.15	4.00	3.58	4.60	7.19
April	6.95	5.03	8.95	4.33	5.13	8.19	8.19	8.01	7.91	7.10	6.10	7.19	5.58	4.42	3.00	3.27	4.18	3.69	4.60	6.32
May	6.88	5.05	8.55	4.99	5.51	7.39	7.27	8.08	7.75	6.60	6.13	7.00	5.51	3.82	3.00	3.65	4.14	3.96	4.60	6.00
June	7.55	5.34	8.48	4.56	5.73	7.14	7.08	8.35	8.08	6.42	6.30	7.00	5.41	3.92	2.99	4.17	3.98	4.02	4.60	6.00
July	8.04	5.65	8.67	4.40	5.75	6.28	7.15	8.33	8.60	6.33	6.22	6.80	5.25	4.40	2.73	4.46	3.77	4.12	4.60	6.00
Aug.	8.05	5.77	8.98	4.40	5.88	6.74	8.02	9.52	8.96	6.69	6.25	6.75	5.49	4.40	3.24	4.50	3.75	4.25	4.60	6.45
Sept.	8.05	6.12	8.11	4.60	6.20	7.06	8.09	9.60	8.80	6.30	6.45	6.88	5.50	4.40	3.47	4.50	3.68	4.41	4.60	6.40
Oct.	8.05	6.45	7.24	4.70	6.67	6.84	8.31	9.62	8.40	6.25	6.50	6.87	5.17	3.97	3.05	4.32	3.65	4.51	4.63	5.75
Nov.	8.05	6.76	6.33	4.70	7.20	6.87	8.96	9.84	8.00	6.27	6.39	6.29	5.10	3.94	3.04	4.29	3.57	4.50	5.11	5.03
Dec.	6.71	7.03	4.80	4.70	7.28	7.61	9.61	9.36	7.87	6.52	6.49	6.25	5.10	3.80	3.00	4.14	3.60	4.50	5.55	4.87
Aver.	*7.46*	*5.76*	*8.07*	*4.58*	*5.79*	*7.39*	*8.27*	*9.10*	*8.39*	*6.75*	*6.31*	*6.83*	*5.52*	*5.25*	*3.18*	*3.87*	*3.86*	*4.06*	*4.71*	*6.02*

Straits Tin, at New York, Cents a Pound

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	35.94	32.03	39.16	48.70	58.26	62.20	66.43	55.56	49.21	38.84	26.03	21.80	22.70	51.98	50.91	47.23	50.90
Feb.	32.16	30.74	41.98	53.41	57.09	63.65	69.05	52.47	49.39	38.63	26.27	21.97	23.51	51.78	49.99	47.94	52.10
March	28.79	29.14	48.61	55.03	53.67	64.47	69.23	52.11	48.85	36.76	27.02	21.81	24.35	53.84	46.88	48.00	62.74
April	30.36	30.58	45.84	50.02	52.27	63.35	67.88	52.28	45.93	35.90	25.13	19.17	27.16	55.66	50.05	46.97	59.02
May	32.50	30.92	43.11	44.08	54.65	62.36	67.47	51.53	43.88	32.16	23.16	20.90	35.94	53.57	51.10	46.31	55.64
June	29.39	31.46	40.97	42.74	55.93	60.63	67.42	47.92	44.20	30.26	23.53	19.58	44.23	51.31	51.08	42.24	55.88
July	27.69	31.67	38.47	46.29	58.05	62.98	64.01	47.01	46.29	29.76	24.96	20.89	46.28	51.94	52.31	42.96	59.34
Aug.	26.35	32.36	39.33	41.89	58.12	65.17	64.41	47.97	46.60	30.00	25.73	22.98	44.71	51.99	50.46	42.57	59.40
Sept.	26.70	32.36	41.60	49.24	58.27	68.89	61.43	48.06	45.32	29.59	24.51	24.76	46.46	51.52	49.05	44.77	58.64
Oct.	27.70	34.61	41.80	50.60	62.24	70.36	58.49	48.99	42.25	26.76	22.72	23.91	47.95	51.01	51.25	44.95	51.52
Nov.	28.93	36.76	44.09	54.25	63.30	70.75	57.49	50.76	40.18	25.87	22.78	23.31	53.14	51.24	51.88	51.30	43.34
Dec.	32.41	37.48	47.16	56.03	62.94	68.68	58.54	50.23	39.87	25.01	21.28	22.70	52.91	50.92	49.17	51.85	43.03
Aver.	*29.91*	*32.51*	*42.68*	*50.19*	*57.90*	*64.29*	*64.32*	*50.39*	*45.16*	*31.63*	*24.43*	*21.98*	*39.12*	*52.23*	*50.39*	*46.42*	*54.30*

Aluminum (No. 1 Virgin, 99 Per Cent Plus), at New York, Cents a Pound, Less-than-ton Lots

	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	22.86	17.74	22.75	27.61	27.00	27.00	26.37	23.90	23.90	23.90	20.50	19.50	19.00	19.75	21.00	21.00	21.00
Feb.	24.50	17.33	23.25	27.71	27.00	27.00	25.83	23.90	23.90	23.90	20.50	19.50	19.00	19.75	21.00	21.00	21.00
March	23.44	17.52	24.95	27.57	27.00	27.00	25.55	23.90	23.90	22.90	20.00	19.00	19.00	20.00	21.00	21.00	21.00
April	23.25	18.07	26.00	27.46	27.00	27.00	25.55	23.90	23.90	20.50	19.50	18.50	19.50	20.00	21.00	21.00	21.00
May	23.06	17.92	26.24	26.43	27.00	27.00	25.55	23.90	23.90	20.50	19.50	18.00	19.50	20.50	21.00	21.00	21.00
June	22.75	17.87	26.25	26.27	27.00	27.00	25.55	23.90	23.90	20.50	19.50	18.00	19.50	21.00	21.00	21.00	21.00
July	22.62	17.87	26.25	26.37	27.00	27.00	25.55	23.90	23.90	20.50	19.50	18.00	19.50	21.00	21.00	21.00	21.00
Aug.	20.22	17.87	26.07	26.52	27.00	27.00	25.55	23.90	23.90	20.50	19.50	18.00	19.50	21.00	21.00	21.00	21.00
Sept.	19.02	18.26	25.50	27.24	27.00	27.00	25.55	23.90	23.90	20.50	19.50	18.00	19.50	21.00	21.00	21.00	21.00
Oct.	17.85	20.32	25.50	27.16	27.24	27.00	25.29	23.90	23.00	20.50	19.50	18.00	19.50	21.00	21.00	21.00	21.00
Nov.	17.50	20.87	25.80	27.00	28.00	27.00	24.30	23.90	23.90	20.50	19.50	18.00	19.50	21.00	21.00	21.00	21.00
Dec.	17.50	22.52	26.31	27.00	28.00	26.85	24.26	23.90	23.90	20.50	19.50	18.50	19.50	21.00	21.00	21.00	21.00
Aver.	*21.21*	*18.68*	*25.41*	*27.03*	*27.19*	*26.99*	*25.41*	*23.90*	*23.90*	*21.27*	*19.71*	*18.42*	*19.38*	*20.58*	*21.00*	*21.00*	*21.00*

* December, 1937, estimated.

*Monthly Average Scrap Prices Computed from

No. 1 Heavy Melting Steel

(Average of Pittsburgh, Chicago and

	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919
Jan.	$17.85	$19 75	$11.40	$16 19	$16.51	$18.12	$11.85	$15.84	$16.90	$12.50	$11.77	$14.02	$10.29	$10.27	$16.46	$21.73	$29.93	$17.77
Feb.	18.32	19.82	12.31	15.79	15.52	17.50	13.54	14.92	16.42	13.15	11.46	13 06	11.39	10.39	16.10	21.35	29.92	14.75
March	19.31	20.02	13.17	15.99	14.50	17.62	12.58	13.27	16.10	13.43	11.71	13.10	11.10	10.78	17.28	23.60	29.58	14.52
April	19.94	20.20	13.19	15.98	14.98	17.48	12.20	13.20	15.69	12.63	12.44	13.39	10.83	10.61	17.42	26.63	28.47	15.79
May	20.50	19.81	11.46	14.50	14.93	17.55	12.08	14.33	14.54	12.07	12.85	12.30	10.60	10.79	16.47	27.63	28.79	15.06
June	21.10	19.00	10.65	13.47	14.84	17.79	12.67	15.23	14.23	12.06	12.94	11.60	10.57	10.78	15.25	37.21	28.87	16.54
July	21.35	18.33	10.29	13.97	14.92	17.27	13.27	15.25	13.67	12.21	12.82	11.42	10.50	11.65	15.19	36.00	29.00	19.13
Aug.	20.75	17.29	10.79	14.52	15.78	16.57	13.73	16.06	13.43	12.50	13.19	11.46	10.42	13.00	15.35	31.30	29.00	20.25
Sept.	21.00	15.62	11.13	15.32	17.11	16.21	14.15	16.93	13.50	11.94	13.73	11.35	10.30	13.79	15.67	31.50	29.00	18.87
Oct.	21.03	13.98	12.00	15.85	17.28	15.72	14.55	17.46	13.44	11.27	14.90	11.00	9.71	13.62	16.90	26.60	29.00	18.67
Nov.	20.75	12.12	13.85	16.75	18.07	13.48	15.56	17.17	13.30	11.02	14.69	10.39	9.13	14.63	20.40	27.83	28.50	20.50
Dec.	20.63	10.48	15.52	16.79	18.88	12.00	16.32	17.17	12.75	11.52	14.00	9.97	9.50	16.20	24.13	28.87	25.00	22.77
Aver.	*20.22*	*17.20*	*12.15*	*15.43*	*16.11*	*16.44*	*13.54*	*15.58*	*14.50*	*12.19*	*13.04*	*11.92*	*10.36*	*12.21*	*17.22*	*29.19*	*28.76*	*17.89*

Scrap Prices at Pittsburgh, Gross Ton

No. 1 Heavy Melting Steel

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$26.30	$15.50	$14.30	$21.80	$21.38	$21.50	$18.63	$16.88	$15.10	$19.31	$16.69	$13.19	$10.22	$8.30	$13.00	$13.35	$14.44	$19.25
Feb.	27.75	16.00	14.00	23.25	20.88	19.50	17.50	16.13	14.94	18.63	16.81	12.88	10.25	8.50	14.00	13.06	14.96	19.56
March	27.25	14.00	15.13	25.38	19.38	18.50	17.55	16.55	14.81	18.44	16.56	12.80	10.25	8.88	14 44	12.19	15.75	22.90
April	26.00	12.63	16.38	25.88	16.20	17.00	16.63	16.50	15.31	18.60	15 95	12 39	10 12	10.00	14.19	11.55	15.75	22.00
May	25.00	13.30	17.30	22.80	15.63	16.75	15.69	15.40	15.25	17.88	15.25	11.25	9.60	11.75	12.80	11.62	14.50	19.12
June	25.00	12.69	17.00	21.13	16.00	17.30	15.75	14.81	14.56	18.25	15.13	10.30	8.75	11.75	11.75	11.75	13.57	18.20
July	26.00	12.00	17.38	18.10	17.50	18.00	16.81	15.00	14.10	18.55	14.75	10.56	8.25	12.72	11.75	11.95	14.19	19.75
Aug.	28.13	12.79	17.75	17.75	17.50	18.88	17.50	15.40	15.50	19.00	15.13	10.69	8.60	13.85	11.31	12.94	15.94	21.85
Sept.	29.00	13.63	20.13	17.88	18.10	18.70	17.88	15.50	16.56	18.31	15.60	10.65	9.54	12.94	10.75	13.25	17.80	19.62
Oct.	27.75	14.13	21.40	15.70	18.50	18.50	17.25	14.75	17.60	17.30	14.56	10.22	9.62	12.15	10.35	13.40	17.87	16.62
Nov.	23.50	14.30	20.50	16.13	19.63	19.50	17.20	14.25	17.19	16.39	13.19	10.22	9.15	11.50	10.94	13.56	17.31	13.75
Dec.	17.20	14.25	20.13	18.75	21.40	19.10	16.75	14.88	17.90	15.45	12.75	10.25	8.75	12.13	13.01	14.05	18.31	13.58
Aver.	*25.74*	*13.76*	*17.62*	*20.38*	*18.51*	*18.60*	*17.10*	*15.50*	*15.74*	*18.01*	*15.20*	*11.28*	*9.42*	*11.21*	*12.56*	*12.72*	*15.87*	*18.85*

Machine Shop Turnings

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$15.50	$10.00	$9.60	$16.90	$15.75	$17.50	$14.30	$12.00	$10.80	$11.50	$11.50	$6.00	$6.50	$6.25	$8.70	$8.70	$ 9.87	$14.00
Feb.	17.88	10.00	9.56	18.50	16.13	15.88	13.63	11.38	10.88	11.50	11.39	6.44	6.50	6.25	10.25	8.75	10.25	14.00
March	18.00	9.40	10.50	20.38	14.50	14.20	13.35	12.00	10.25	10.63	10.94	7.65	6.75	6.25	11.00	7.31	10.50	14.50
April	16.70	8.13	11.88	20.50	12.45	13.39	12.00	12.63	10.44	11.15	10.90	7.06	6.56	6.81	10.38	7.30	10.50	14.37
May	13.38	8.70	13.30	19.20	11.88	12.25	11.00	11.30	10.20	11.06	10.19	6.57	6.00	8 30	8.35	8.06	9.69	14.31
June	14.75	7.56	13.32	17.19	13.00	13.05	11.00	10.50	9.00	11.63	9.56	6.50	5.12	8.38	7.25	8.12	9.05	13.85
July	13.40	7.00	14.00	12.10	13.50	13.63	11.38	11.50	9.10	11.90	8.60	6.75	4 75	9.50	7.50	8.10	9.37	14.25
Aug.	15.25	7.85	14.00	11.44	14.13	15.00	12.80	11.80	9.88	13.00	8.00	7.00	5.30	10.50	7.50	8.88	10.62	15.65
Sept.	16.30	9.06	14.75	12.88	14.40	14.75	13.06	11.63	11.13	12.06	8.00	7.30	6.00	10.00	7.13	9.50	12.20	14.50
Oct.	15.88	9.56	16.20	11.60	14.25	14.39	12.06	11.50	11.10	11.75	6.88	7.00	6.00	9.30	6.75	9.50	12.25	11.62
Nov.	14.63	9.85	16.63	11.63	15.94	15.00	11.90	11.10	11.00	11.00	6 00	6.94	6.00	7.75	7.13	9.44	11.50	8.45
Dec.	10.50	8.88	15.63	13.75	17.20	14.30	11.50	11.00	11.10	10.25	6.00	6.70	6.12	8.00	8.70	9.60	12.37	7.42
Aver.	*15.35*	*8.83*	*13.28*	*15.51*	*14.43*	*14.44*	*12.34*	*11.53*	*10.41*	*11.45*	*8.98*	*6.83*	*5.97*	*8.11*	*8.39*	*8.61*	*10.68*	*13.08*

Cast Iron Borings

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$18.70	$13.00	$10.90	$18.40	$16.94	$17.50	$14.88	$12.50	$11.30	$12.88	$11.25	$7 50	$6.50	$5.50	$7.50	$6.35	$ 8.50	$14.00
Feb.	20.25	12.00	11.06	19.50	16.88	15.88	14.13	12.13	11.00	12.50	11.56	7.50	6.50	5.50	7.88	6.75	8.75	14.00
March	19.50	11.45	11.94	21.13	15.38	14.10	13.30	12.50	10.50	12.25	11.00	7.70	6.70	5.50	8.50	6.37	10.50	14.40
April	18.60	9.38	13.38	21.88	13.00	13.39	12.50	12.38	11.00	12.45	10.55	7.50	6.56	5.88	8.50	6.00	10.50	14.25
May	17.38	9.70	14.10	20.20	12.75	12.50	11.75	11.10	10.90	12.00	10.39	7.63	6.10	7.30	8.10	6.00	10.12	14.00
June	16.75	8.38	14.63	17.88	14.00	13.05	11.90	10.50	10.39	12.25	9.88	6.75	5.12	7.88	7.00	6.25	10.00	14.30
July	18.00	7.63	16.00	15.20	13.80	13.63	12.38	10.63	10.00	12.40	8.90	7.25	4.50	9.25	7.00	6.30	10.00	14.87
Aug.	19.63	8.30	15.70	13.88	14.75	15.00	12.75	11.00	10.75	12.75	8.50	7.56	5.30	9.95	7.00	6.63	10.62	15.45
Sept.	20.20	9.00	17.00	15.63	14.90	14.75	12.94	11.00	12.13	12.25	8.65	7.20	6.00	8.88	6.75	7.00	12.30	14.87
Oct.	19 00	10.13	18.60	13.50	15.00	14.39	12.50	11.00	12.50	12.25	8.00	7.25	6.00	8.20	5.50	8.00	12.50	12.75
Nov.	17.38	10.40	17.85	12.75	15.13	15.00	12.90	11.00	12.13	11.63	7.75	6 94	6.00	7.75	5.25	8.00	12.25	8.55
Dec.	14.00	9.25	17.50	14.88	16.70	14.90	12.13	11.13	12.00	10.75	7.40	6.70	5.50	7.50	5.40	8.00	12.87	6.75
Aver.	*18.28*	*9.88*	*14.89*	*17.07*	*14.94*	*14.51*	*12.84*	*11.57*	*11.22*	*12.20*	*9.49*	*7.29*	*5.89*	*7.42*	*7.03*	*6.80*	*10.74*	*13.18*

No. 1 Cast Cupola Scrap

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$32.00	$25.00	$16.30	$23.30	$21.00	$19.63	$17.50	$16.00	$14.50	$16.00	$14.00	$12.00	$9.50	$8.60	$11.40	$12.80	$14.00	$17.12
Feb.	34.00	22.75	16.00	24.75	21.38	20.13	17.00	15.56	14.50	15.00	14.00	12.00	9.50	8.50	12.25	13.37	14.00	17.50
March	34.00	21.20	15.94	26.75	20.25	18.60	17.00	15.80	14.50	15.13	14.00	12.00	9.20	8.50	13.50	12.50	14.80	19.20
April	33.00	18.00	16.88	27.75	18.50	17.75	16.50	16.00	14.50	14.39	14.00	12.00	9.00	8.75	13.50	12.00	15.00	20.00
May	32.00	18.00	18.50	26.30	17.88	17.50	16.50	15.70	14.50	15.50	14.00	10.75	8.90	9.90	12.80	12.63	15.00	19.37
June	32.00	16.63	18.75	24.13	17.25	17.10	15.90	15.13	14.25	15.50	14.00	10.00	8.50	10.00	12.00	13.00	14.60	18.30
July	40.20	16.00	19.00	21.10	17.80	17.00	15.75	15.00	14.25	15.50	13.00	10.00	8.87	10.63	12 00	13.00	14.50	19.25
Aug.	41.25	16.20	19 00	21.38	18.00	17.50	16.80	15.00	14.50	15.50	13.00	10.50	9.00	11.50	11.75	13 44	15.50	20.25
Sept.	42.00	16.88	22.13	21.75	18.00	17.40	16.50	15.00	14.94	15.50	13 00	10.10	9.50	11.50	11.50	14.00	15.90	19.75
Oct.	39.75	17.50	24.00	19.50	18.00	17.39	16.00	14.75	15.40	15.50	12.88	9.50	9.50	11.50	11.00	14.00	16.00	18.38
Nov.	34.25	17.10	23.13	18.63	18.13	18.00	16.30	14.35	15.00	15.13	12 13	9 50	9.10	11.00	11.19	14.00	16.00	16.65
Dec.	27.25	16.13	22.38	20.00	19.10	17.70	16.00	14.38	14.80	14.50	12.00	9.50	9.00	11.00	12.25	14.00	16.50	16.25
Aver.	*35.14*	*18.45*	*19.33*	*22.95*	*18.77*	*17.98*	*16.48*	*15.22*	*14.64*	*15.34*	*13.33*	*10.65*	*9.13*	*10.12*	*12.09*	*13.23*	*15.15*	*18.50*

Compressed Sheets

	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$18.81	$16.39	$12.50	$9.56	$8.00	$12.35	$12.75	$14.19	$19.25
Feb.	18.31	16 19	12.56	9.56	8.13	13.44	12.63	14.69	19.56
March	18.25	15.75	12.55	9 70	8 44	14 13	11.87	15.50	22.90
April	18.55	15.60	11.94	9.50	9.50	13 88	11.10	15.50	22.00
May	17.81	15 06	10.88	8.95	11.15	12.45	11.19	14.25	19.37
June	18.13	14.81	9.75	8.12	11.50	11.00	11.25	13.35	18.30
July	18.25	14.65	10.06	7.50	12.19	11.00	11.55	13.81	19.75
Aug.	18.44	14.94	10.13	7.80	13.05	10.81	12 69	15.69	21.80
Sept.	18.19	14.95	10.35	9.25	12.63	10.44	13.00	17.55	19.88
Oct.	17.15	14.19	9.63	9 12	11.90	10.10	13.20	17.50	16.63
Nov.	16.13	12.81	9.75	8.65	11.25	10 63	13.31	17.06	13.75
Dec.	15.15	12.00	9.80	8.31	11.63	12.44	13.90	18.06	13.58
Aver.	*17.77*	*14.78*	*10.86*	*8.83*	*10.78*	*11.89*	*12.37*	*15.60*	*18.90*

Low-Phosphorus Scrap (Billet and Bloom Crops)

	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$22.00	$20.88	$17.25	$13.00	$10.70	$15.70	$15.00	$16.88	$24.50
Feb.	22.00	21.25	18.00	13.00	10.50	16.25	15.00	17.12	25.50
March	22.50	21.50	18.00	13.00	10 50	17.00	14.62	18.00	26.90
April	23.45	21.40	17.50	13.00	11.00	17.00	14.55	18.00	27.50
May	22.50	19.88	15.00	12.40	13.80	16.20	14.94	17.62	25.87
June	22.25	19.13	14.10	10.87	14.00	15.25	15.00	17.50	25.00
July	22.45	19.20	14.50	10 50	15.00	15 00	15.00	17.50	25.00
Aug.	23.00	19.33	14.50	10.50	16.80	14.25	15.50	18.62	26.85
Sept.	22.39	20.00	14 30	10.50	15.75	13.50	16.12	20.50	25.12
Oct.	21.75	18.75	13.50	11.00	15.20	13.00	16.50	21.00	21.37
Nov.	21.13	17.13	13.00	11.50	15.00	13.81	16.50	21.00	18.05
Dec.	20.75	17.00	13.00	11.00	15.06	14.81	16.50	22.12	18.25
Aver.	*22.18*	*19.63*	*15.22*	*11.69*	*13.61*	*15.15*	*15.44*	*18.82*	*24.16*

*December, 1937, prices do not include quotations in Dec. 30 issue.

Weekly Quotations in THE IRON AGE

Scrap Composite Price

Philadelphia Quotations, Gross Ton)

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$25.13	$14.04	$12.45	$20.22	$19.15	$20.10	$16.97	$15.17	$13.70	$17.02	$14.65	$11.30	$8.41	$6.77	$11.73	$12.29	$13.47	$18.33
Feb.	26.00	15.21	12.46	21.46	19.21	18.27	15.50	14.58	13.71	16.96	14.92	11.15	8.27	6.83	12.25	11.98	14.12	19.27
March	25.50	13.17	13.46	24.79	17.56	16.92	15.83	14.65	13.65	16.71	14.88	11.10	8.23	6.96	12.82	11.06	14.75	21.25
April	24.42	11.63	14.71	24.00	15.20	15.48	15.27	14.71	13.81	17.18	14.30	10.83	8.12	7.73	12.54	10.46	14.59	21.02
May	23.71	12.20	15.67	20.77	14.71	15.46	14.35	13.95	13.90	16.54	13.71	9.94	7.48	9.70	11.57	10.70	13.39	18.54
June	23.47	11.47	15.52	18.94	14.88	16.09	14.40	13.60	13.52	16.39	13.31	9.39	6.89	9.97	10.67	10.74	12.81	17.28
July	24.21	11.00	15.92	17.23	16.00	16.46	15.42	13.48	13.13	16.60	13.08	9.25	6.46	11.27	10.53	10.96	13.29	18.79
Aug.	25.88	11.57	16.30	16.58	16.58	17.23	15.88	13.80	13.75	16.86	13.29	9.25	6.93	12.08	10.15	12.25	15.04	20.43
Sept.	26.53	12.15	18.33	16.98	17.20	17.42	16.25	13.92	14.75	16.60	13.70	9.12	7.69	11.35	9.63	12.71	16.45	18.73
Oct.	23.73	12.88	19.20	15.15	17.08	17.08	15.58	13.48	15.85	15.78	12.77	8.78	7.62	10.56	9.54	12.67	16.63	15.89
Nov.	20.00	12.73	18.02	15.13	18.17	17.63	15.25	13.18	15.73	14.83	11.69	8.74	7.45	9.94	10.04	12.10	16.31	13.34
Dec.	15.92	12.29	17.94	17.37	20.08	17.37	15.08	13.48	15.97	14.15	11.28	8.61	6.92	10.50	11.43	13 33	17.10	13.36
Aver.	*23.71*	*12.61*	*15.83*	*19.05*	*17.16*	*17.12*	*15.48*	*14.00*	*14.29*	*16.30*	*13.46*	*9.80*	*7.54*	*9.47*	*11.07*	*11.85*	*14.75*	*18.02*

Eastern Pennsylvania Scrap Prices, Gross Ton

No. 1 Heavy Melting Steel

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$24.75	$14.50	$11.60	$19.70	$18.20	$18.50	$17.00	$15.39	$13.50	$16.39	$14.50	$10.50	$7.00	$6.75	$11.70	$11.40	$12.62	$17.37
Feb.	25.62	14.25	12.00	20.75	18.38	17.63	15.88	14.63	13.50	16.39	14.63	10.50	7.00	6.75	11.75	11.62	13.25	18.50
March	25.20	13.00	12.78	25.25	16.75	15.90	16.00	14.50	13.50	16.13	14.88	10.50	7.00	6.75	11.88	10.50	13.75	19.60
April	24.12	11.25	14.00	23.63	15.30	14.63	16.00	14.50	13.50	17.00	13.95	10.31	7.50	7.19	11.69	10.00	13.69	20.00
May	23.37	11.80	14.75	19.80	14.75	14.63	15.25	14.10	13.50	16.39	13 39	9.69	6.00	8.90	10.95	10.44	12.81	18.62
June	22.60	11.25	15.00	17.88	15.00	15.10	14.70	14.00	13.39	16.00	12.75	9.10	6.00	9.25	10.50	10.50	12.00	17.20
July	22.62	11.00	15.00	16.60	15.40	15.63	14 63	13.39	13.00	16.50	12.50	8.44	6.00	10.68	10.30	10.55	12.31	19.00
Aug.	25.00	11.40	15.20	16.00	16.75	16.38	16.20	13.70	13.00	16.50	12.63	8.69	6.30	11.95	9.94	11.44	14.00	19.75
Sept.	25.62	11.50	16.88	16.75	17.10	17.20	16.88	14.00	14.75	16.39	13.00	8.50	7.25	11.25	9.63	12.38	15.40	19.00
Oct.	22.75	12.06	17.80	15.40	16.63	16.75	16.50	14.00	16.00	15.70	12.38	8.13	7.25	10.20	9.53	12.10	15.75	16.38
Nov.	19.00	11.88	16.25	15.25	17.75	17.38	15.50	13.80	15.50	15.00	11.75	8.00	7.25	9.75	9.94	12 1(	15.12	13.75
Dec.	15.25	11.50	16.38	16.75	20.10	17.50	15.50	13.50	15.40	14.50	11.10	7.75	6.75	10.44	10.75	12 50	15.50	14.25
Aver.	*23.99*	*12.12*	*14.80*	*18.65*	*16.84*	*16.44*	*15.84*	*14.13*	*14.05*	*16.07*	*13.12*	*9.18*	*6.77*	*9.16*	*10.71*	*11.30*	*13.85*	*17.78*

No. 1 Machinery Cast

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$36.00	$23.25	$16.50	$23.20	$20.70	$20.13	$18.39	$17.00	$16.00	$16.31	$15.00	$12.00	$10.00	$8.00	$12.00	$10.90	$13.00	$18.50
Feb.	40.00	23.00	16.50	24.25	20.25	18.88	17.75	17.00	16.00	16.50	15.00	11.90	10.00	8.00	12.00	11.00	13.00	19.00
March	39.20	19.40	17.13	28.25	18.63	18.00	17.50	17.00	16.00	16.50	15.00	11.50	9.90	8.00	12.75	11.00	14.00	20.40
April	38.00	18.00	17.25	26.25	17.70	17.25	17.50	17.00	16.00	16.50	14.85	11.50	9.75	8.50	12.88	11.00	13.87	22.25
May	37.75	18.00	18.40	24.30	17.00	17.00	17.25	16.80	16.00	16.50	14.00	11.50	8.12	10.25	12.10	11.00	13.50	20.87
June	37.00	17.38	19.00	22.25	17.50	17.50	17.00	16.00	16 00	16.00	13.50	11.20	8.00	10.25	12.00	11.00	13.50	20.00
July	37.50	16.50	17.50	20.40	17.50	17.63	17.00	16.00	15.50	16.50	13.00	11.00	6.50	11.81	11.60	11.00	14.12	20.37
Aug.	39.00	17.00	18.60	20.38	17.88	18.00	17.70	16.00	15.50	16.50	13.00	11.00	8.20	12.50	11.50	11.12	15.19	21.15
Sept.	39.25	17.00	21.50	21.38	18.00	18.00	18.00	16.38	16.25	16.88	13.00	11.00	9.25	12.50	11.50	11.50	16.30	20.38
Oct.	38.75	17.13	22.60	19.50	17.50	18.00	17.39	16.50	17.10	16.00	13.00	11.00	9.50	11.50	11.10	12.10	16.50	19.12
Nov.	33.80	17.50	21.00	19.25	17.88	18.00	17.30	16.13	16.39	15.88	12.00	11.00	9.31	11.25	10.50	12 50	16.50	16.85
Dec.	24.50	16.63	20.25	20.25	19.50	18.13	17.00	16.00	16.25	15.00	12.00	10.10	8.00	11 81	10.50	12 90	16.75	16.58
Aver.	*36.73*	*18.49*	*18.85*	*22.47*	*18.34*	*18.04*	*17.48*	*16.48*	*16.08*	*16.28*	*13.61*	*11.23*	*8.88*	*10.36*	*11.70*	*11.48*	*14.69*	*19.62*

No. 1 Railroad Wrought

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$33.50	$20.00	$14.50	$22.10	$20.90	$20.88	$18.39	$17.00	$15.25	$15.50	$15.00	$13.13	$9.00	$7.50	$11.00	$11.00	$12.50	$16.50
Feb.	36.00	19.75	14.63	24.75	21.50	20.13	17.75	17.00	15.06	16.00	15.00	12.00	8.50	7.50	11.00	10.87	13.00	17.37
March	35.90	17.20	15.38	27.50	19.00	18.90	17.20	17 00	14.60	16.00	15.00	12.00	8.50	7.50	11.00	10.63	13.00	19.10
April	35.00	17.00	15.88	27.00	18.10	17.75	17.50	16.50	14.50	16.00	15.00	11.25	9.00	7.62	11.50	10.40	14.25	19.75
May	33.50	15.20	16.90	24.20	16.63	17.50	17.25	16.50	14.50	16.00	15.00	11.00	7.19	10.75	12.00	10.00	14.62	19.50
June	33.00	14.38	17.00	22.50	16.50	18.10	16.60	16.00	13.75	16.00	15.00	10.20	7.00	10.75	12.00	10.00	14.50	19.50
July	33.00	13.50	17.13	18.80	17.70	17.63	16.50	15.75	13.50	16.00	15.00	10.00	7.00	11.06	11.20	10.00	14.50	19.75
Aug.	33.00	14.00	18.00	18.00	18.63	17.50	17.80	15.50	13.50	16.00	15.00	10.00	7.00	12.00	11.00	10.37	14.50	20.15
Sept.	33.25	15.00	20.88	18.50	19.00	17.70	17.88	15.50	14.50	16.00	15.00	10.00	7.50	12.00	11.00	12.00	15.10	20.62
Oct.	29.25	15.88	22.20	17.50	18.00	18.13	17.00	15.50	15.60	16.00	14.75	10.00	7.50	11.20	11.00	12.00	15.87	19.38
Nov.	25.00	16.00	19.00	17.38	18.38	18.50	17.00	15.30	16.00	15.88	13.75	10.00	7.50	11.00	11.00	12 00	16.00	16.85
Dec.	20.00	14.63	19.25	18.50	20.40	18.50	17.00	15.25	16.00	15.40	13.50	9.50	7.50	11.00	11.00	12 00	16.00	16.25
Aver.	*31.70*	*16.04*	*17.56*	*21.39*	*18.73*	*18.44*	*17.32*	*16.07*	*14.73*	*15.90*	*14.75*	*10.75*	*8.60*	*9.99*	*11.22*	*10.94*	*14.48*	*18.73*

Cast Iron Carwheels

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$36.00	$25.00	$16.50	$22.30	$20.10	$19.50	$18.13	$16.38	$15.50	$16.50	$15.00	$13.75	$10.75	$8.00	$11.90	$11.50	$13.75	$18.37
Feb.	40.63	24.00	15.00	24.75	20.38	18.38	17.50	16.00	15.50	16.50	15.00	13.50	10.00	8.00	12.50	12.25	14.50	18.50
March	42.40	18.50	15.94	26.50	18.75	18.50	17.50	16.00	15.50	16.50	15.00	13.40	9.70	8.00	12.88	11.87	14.50	19.30
April	40.00	18.00	15.88	26.50	17.50	17.75	17.50	16.00	15.50	16.50	15.00	12.63	10.00	8.75	13.00	11.00	14.37	21.25
May	40.00	16.80	24.20	17.00	17.00	17.00	17.25	16.00	15.50	16.39	14.88	12.25	8.94	9.75	12.50	11.00	13.62	20.62
June	38.00	18.00	17.13	22.75	17.00	17.00	17.00	15.38	15.50	16.00	14.50	12.00	8.25	10.25	11.38	11.00	13.50	19.50
July	38.50	16.50	17.50	20.40	17.30	17.25	17.00	15.00	15.50	16.39	14.50	12.00	7.00	12.00	11.00	11.00	13.87	19.75
Aug.	40.60	16.40	18.10	20.25	17.75	18.50	17.40	15.30	15.50	16.50	14.63	12.00	8.40	12.75	11.00	11.13	15.25	20.55
Sept.	42.75	17.00	21.75	21.00	18.00	18.50	17.50	15.50	15.88	16.50	15.00	12.00	9.50	12.00	11.00	11.50	16.30	20.62
Oct.	40.50	17.00	22.50	19.60	17.50	18.50	17.13	15.50	16.50	16.50	15.00	12.00	9.75	11.85	10.65	12.30	16.50	19.13
Nov.	36.40	17.20	20.50	17.75	17.88	18.50	16.60	15.50	16.50	15.75	14.38	12.00	9.31	10.75	10.37	12 50	16.50	16.85
Dec.	26.00	16.63	20.00	19.50	19.20	18.50	16.50	15.50	16.50	15.50	14.00	11.50	8.50	11.00	11.30	12 90	16.75	16.25
Aver.	*38.48*	*18.42*	*18.13*	*22.18*	*18.20*	*18.16*	*17.22*	*15.67*	*15.78*	*16.29*	*14.74*	*12.42*	*9.17*	*10.26*	*11.62*	*11.66*	*14.96*	*19.22*

Scrap Prices at Cincinnati, Net Ton

No. 1 Machinery Cast

	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$14.00	$20.39	$20.50	$20.12	$19.75	$17.00	$14.30	$17.14	$16.52	$12.60	$10.00	$7.55	$9.50	$10.25	$11.37	$15.75
Feb.	13.63	21.75	21.50	19.12	19.39	16.00	14.30	17.24	16.52	12.60	10.00	6.50	9.50	9.94	11.75	16.12
March	14.05	23.65	20.00	18.35	19.00	16.00	13.85	17.19	16.52	12.60	10.00	6.50	10.00	9.19	12.40	17.30
April	15.50	24.75	18.00	17.75	17.80	16.00	13.85	17.19	16.52	11.90	10.00	6.50	10.00	8.75	12.19	17.37
May	16.25	24.05	16.75	17.75	17.00	15.60	13.65	17.19	15.85	11.25	10.00	6.75	9.45	8.87	11.50	14.44
June	16.25	22.13	17.13	18.15	17 00	15.50	13.60	17.19	15.63	11.25	8.50	7.13	9.00	9.06	11.20	14.00
July	16.25	20.25	18.25	18.25	17.00	15.50	13.55	17.19	15.63	11.25	8.00	8.75	9.00	9.10	11.19	14.87
Aug.	17.45	19.05	18.25	19.00	17.63	15.50	13.40	17.05	15.63	11.25	7.50	9.50	8.88	9.94	12.43	16.25
Sept.	19.88	19.38	18.13	19.25	18.00	15.50	14.20	16.96	13 48	9.45	8.00	9.50	8.75	10.00	13.60	14.25
Oct.	21.25	18.00	17.68	19.00	17.39	15.50	15.65	16.92	12.95	9.04	8.25	9.50	8.75	10.50	14.00	13.38
Nov.	20.85	16.85	18.40	20.12	17.00	14.50	16.70	16 57	13.95	8.93	8 25	9.12	8.88	10.50	14.00	11.85
Dec.	20.75	18.00	18.75	20.00	17.00	14 00	16 50	16.52	12 59	8.93	8 25	9.19	9.85	10.90	15.12	10.75
Aver.	*17.18*	*20.69*	*18.61*	*18.91*	*17.83*	*15.55*	*14.47*	*17.03*	*15.07*	*10.92*	*8.90*	*8.04*	*9.30*	*9.75*	*12.56*	*14.69*

*Scrap Prices at Chicago

No. 1 Heavy Melting Steel, Gross Ton

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$24.50	$15.13	$11.45	$19.15	$17.69	$19.44	$15.12	$13.25	$12.50	$15.39	$12.75	$10.27	$7.50	$5.25	$10.50	$11.80	$13.37	$17.81
Feb.	25.00	15.13	11.38	20.33	17.88	17.69	13.88	13.00	12.69	15.88	13.31	10.06	7.25	5.25	11.00	11.25	14.19	19.25
March	24.25	12.50	12.38	23.50	16.56	16.45	13.95	12.90	12.63	15.66	13.19	10.00	7.25	5.25	12.13	10.50	14.75	20.00
April	23.75	11.00	13.75	22.50	14.10	14.81	13.19	13.13	12.63	15.95	13.00	9.81	7.14	6.00	11.75	9.85	14.34	20.56
May	23.00	11.50	14.95	19.70	13.75	15.00	12.13	12.35	12.95	15.39	12.50	8.88	6.45	8.45	11.05	10.06	12.87	17.12
June	22.95	10.81	14.56	17.88	13.63	15.75	12.45	12.00	12.63	14.94	12.06	8.75	5.69	8.91	9.75	9.97	12.85	15.70
July	24.13	10.00	15.25	17.05	14.90	15.60	14.19	12.06	12.30	14.75	12.00	8.75	4.88	10.42	9.55	10.35	13.37	17.62
Aug.	25.35	10.60	15.95	16.00	15.50	16.44	14.00	12.30	12.75	15.06	12.13	8.38	5.75	10.46	9.19	12.38	15.19	19.70
Sept.	24.81	11.31	18.13	16.31	16.40	16.35	14.00	12.25	12.94	15.13	12.50	8.20	6.25	9.84	8.50	12.50	16.15	17.56
Oct.	21.50	12.44	18.40	14.15	16.13	16.00	13.00	11.69	13.95	14.30	11.38	8.00	6.00	9.47	8.75	12.50	16.25	14.69
Nov.	18.45	12.25	17.31	14.00	17.13	16.00	13.00	11.50	14.50	13.15	10.13	8.00	5.93	8.60	9.25	13.00	16.50	12.50
Dec.	16.20	11.13	17.25	16.06	18.95	15.75	13.00	12.06	14.55	12.50	10.00	7.80	5.25	8.94	10.50	13.25	17.00	12.25
Aver.	*22.82*	*11.98*	*15.06*	*18.05*	*16.05*	*16.27*	*13.49*	*12.39*	*13.09*	*14.84*	*12.08*	*8.91*	*6.28*	*8.07*	*10.16*	*11.46*	*14.74*	*17.11*

Steel Rerolling Rails, Gross Ton

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$34.25	$15.63	$12.10	$20.40	$18.88	$21.75	$17.50	$16.38	$14.90	$17.00	$14.63	$12.50	$10.50	$7.50	$11.30	$12.60	$14.12	$19.50
Feb.	34.38	15.50	12.00	21.75	20.13	19.25	16.63	15.94	15.00	17.50	15.00	12.00	10.50	7.50	11.81	12.50	15.19	21.00
March	32.30	13.30	13.31	24.63	19.13	17.86	16.50	15.60	14.44	17.50	15.00	12.00	9.85	7.50	12.62	11.88	15.50	22.30
April	32.13	12.63	14.50	23.75	16.30	16.00	16.13	16.00	13.81	17.50	15.00	11.75	9.00	7.88	12.50	11.30	15.19	23.12
May	31.75	13.40	15.70	21.70	15.00	16.88	15.19	15.20	14.40	17.50	14.81	10.69	8.30	9.30	11.90	11.00	14.31	21.62
June	32.65	12.94	15.25	19.25	14.81	17.85	15.45	14.75	14.81	17.50	14.63	8.40	7.31	9.63	10.50	10.62	14.00	19.40
July	35.00	12.25	16.13	18.00	15.50	17.44	17.19	14.88	14.75	17.50	14.50	10.39	6.63	11.32	10.35	11.30	14.37	20.75
Aug.	38.00	12.45	16.90	17.50	16.19	19.00	17.10	15.30	15.13	17.75	14.50	10.13	6.75	12.00	10.00	13.12	15.69	21.75
Sept.	38.13	13.13	19.38	17.38	17.30	19.25	17.39	15.19	15.88	17.81	14.40	10.00	7.19	11.28	10.00	13.50	16.50	20.56
Oct.	33.44	14.00	20.30	15.80	17.06	18.88	16.63	14.88	16.50	17.20	13.88	10.00	8.00	10.88	10.00	13.50	17.00	17.19
Nov.	22.90	13.80	18.38	15.06	18.19	19.44	16.50	14.50	16.63	15.50	12.50	10.25	8.00	9.90	10.06	13.75	17.00	15.05
Dec.	16.90	12.63	17.75	17.00	20.36	19.10	16.19	14.63	16.60	14.60	12.50	10.50	7.50	10.00	10.95	13.80	17.25	15.00
Aver.	*31.90*	*13.47*	*15.98*	*19.35*	*17.40*	*18.56*	*16.53*	*15.27*	*15.24*	*17.07*	*14.28*	*10.72*	*8.29*	*9.57*	*11.00*	*12.41*	*15.51*	*19.77*

Cast Iron Borings, Gross Ton

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$16.11	$10.92	$6.38	$15.57	$13.58	$15.56	$13.39	$10.06	$10.40	$12.50	$9.56	$5.06	$3.38	$3.00	$6.30	$6.80	$6.00	$10.00
Feb.	16.39	11.76	6.93	16.59	15.55	14.63	12.06	10.13	10.13	12.00	10.13	4.75	4.25	3.19	6.56	7.00	6.75	10.87
March	15.74	8.40	8.05	18.91	14.38	13.85	11.75	10.20	9.63	10.63	9.56	4.75	4.20	3.25	7.44	5.94	7.50	12.20
April	15.96	7.28	9.24	17.92	11.40	10.94	10.94	10.44	9.31	10.40	9.25	4.50	3.75	3.88	7.25	5.20	7.00	12.37
May	14.43	6.61	10.98	16.24	10.00	10.00	9.75	10.00	9.25	10.19	8.81	3.75	3.25	5.00	6.45	5.00	6.12	10.75
June	13.38	5.60	11.63	14.43	10.06	10.70	9.95	9.56	9.00	9.88	8.00	3.75	2.63	5.25	5.00	5.00	6.00	10.00
July	14.15	5.32	12.67	13.66	10.45	11.13	11.19	9.94	9.05	7.90	7.90	3.75	2.00	6.25	4.90	5.30	6.12	11.25
Aug.	15.06	5.38	12.88	12.04	10.69	12.75	11.45	10.50	9.31	10.19	7.75	3.94	3.05	6.50	5.00	6.37	7.62	12.15
Sept.	14.65	5.60	14.43	12.19	11.80	13.15	11.19	10.75	9.75	10.50	7.35	4.10	3.88	6.25	4.88	6.00	9.00	10.75
Oct.	12.88	6.44	14.90	10.42	11.56	12.75	8.88	10.13	10.75	10.00	5.75	4.00	3.88	5.88	4.50	6.00	9.25	9.69
Nov.	11.93	6.83	14.56	10.08	12.63	13.19	9.20	9.60	11.69	9.25	4.13	4.00	3.65	5.15	4.81	6.25	9.50	7.85
Dec.	10.98	6.09	14.56	12.04	14.36	13.50	9.50	10.19	11.85	9.15	4.90	3.60	3.06	5.50	6.00	6.10	9.50	7.75
Aver.	*14.30*	*7.19*	*11.43*	*14.17*	*12.21*	*12.68*	*10.77*	*10.13*	*10.01*	*10.37*	*7.76*	*4.16*	*3.41*	*4.93*	*5.75*	*5.91*	*7.53*	*10.47*

Cast Iron Carwheels, Gross Ton

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$36.13	$21.00	$15.30	$26.70	$20.50	$21.38	$18.00	$15.31	$13.90	$14.13	$13.81	$11.00	$8.19	$7.55	$10.70	$11.90	$13.19	$18.25
Feb.	38.06	20.63	15.00	27.25	21.00	19.38	17.13	15.13	14.00	14.50	14.69	10.50	7.50	7.88	11.44	12.00	13.12	18.81
March	36.20	15.90	16.50	28.38	21.00	17.10	17.00	15.00	13.88	14.50	14.69	10.10	6.95	7.00	12.00	10.89	14.00	20.40
April	37.50	14.06	18.63	27.75	16.70	16.00	16.39	15.00	13.50	14.50	14.45	9.50	7.00	8.06	11.75	10.50	14.00	21.25
May	37.50	14.70	18.50	24.10	16.25	16.06	15.25	14.05	13.45	14.50	13.88	9.13	6.40	9.10	11.15	10.50	13.75	19.37
June	35.90	13.31	18.25	21.88	15.63	17.30	15.30	13.50	13.06	14.39	13.55	10.00	5.69	9.50	9.75	10.50	13.50	18.20
July	35.75	12.75	19.25	20.60	16.40	17.12	16.39	13.75	12.80	14.00	13.50	10.00	5.50	10.00	9.55	10.85	13.62	18.87
Aug.	38.35	12.95	20.60	19.50	17.13	17.50	15.90	14.50	12.75	14.00	13.50	9.75	6.30	10.50	9.50	12.75	15.00	19.75
Sept.	37.69	14.19	23.75	19.75	18.20	17.70	15.25	14.25	13.31	14.00	13.50	9.50	7.00	10.25	9.50	12.75	16.00	18.75
Oct.	36.06	16.50	25.10	17.90	17.63	17.38	14.50	13.56	13.85	14.00	13.13	9.30	7.00	9.88	9.50	12.75	16.50	16.94
Nov.	31.95	16.60	24.63	17.88	18.63	18.31	14.50	13.25	14.25	13.88	12.13	8.75	7.00	9.20	10.00	13.00	16.50	14.95
Dec.	24.40	15.75	24.00	19.75	20.70	18.30	14.50	13.44	14.10	13.60	11.75	8.50	7.00	9.50	11.00	13.25	17.50	15.00
Aver.	*35.46*	*15.70*	*19.96*	*22.62*	*18.31*	*17.79*	*15.84*	*14.23*	*13.57*	*14.17*	*13.55*	*9.67*	*6.79*	*9.04*	*10.49*	*11.80*	*14.72*	*18.38*

Railroad Malleable Scrap, Gross Ton

	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$13.60	$18.69	$16.39	$12.75	$7.00	$5.50	$11.10	$13.70	$15.94	$20.12
Feb.	13.50	19.39	17.13	11.94	7.00	5.50	11.75	12.75	16.87	20.87
March	12.63	19.39	16.88	11.70	6.65	5.63	12.25	13.06	18.00	22.45
April	12.75	19.35	16.55	11.13	6.38	6.75	12.00	12.80	17.12	21.69
May	13.00	18.56	15.75	10.25	6.00	9.35	11.30	13.00	15.75	19.50
June	12.69	17.81	13.94	9.55	5.19	9.75	9.75	12.50	15.50	19.20
July	12.50	16.85	13.50	9.00	4.63	10.25	9.55	12.35	15.62	20.25
Aug.	12.88	16.94	13.50	8.43	5.10	10.50	9.38	14.50	17.25	20.75
Sept.	14.39	17.00	13.50	7.50	6.75	9.75	8.75	14.75	18.10	18.75
Oct.	15.30	17.00	13.13	7.40	6.38	9.38	9.00	14.65	18.50	15.93
Nov.	15.88	16.39	12.69	7.25	5.50	8.70	9.13	15.31	18.12	14.15
Dec.	17.00	16.10	12.25	7.00	5.50	9.75	11.20	15.75	19.00	14.67
Aver.	*13.85*	*17.79*	*14.66*	*9.49*	*6.01*	*9.40*	*10.49*	*13.72*	*17.15*	*19.03*

Steel Knuckles and Couplers, Gross Ton

	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$14.65	$16.50	$16.00	$12.00	$8.25	$7.00	$11.10	$12.80	$14.00	$19.19
Feb.	14.50	17.00	16.00	12.00	8.25	7.00	11.69	12.00	15.00	21.00
March	14.06	17.00	15.88	11.80	7.95	7.00	12.62	11.38	16.00	22.60
April	13.81	17.30	15.25	10.56	7.63	6.75	12.25	11.00	15.37	22.75
May	14.50	17.13	14.31	9.75	6.70	9.40	11.45	11.00	14.25	20.12
June	14.25	16.75	13.75	9.75	5.63	9.50	10.00	10.81	14.00	19.60
July	13.75	16.75	13.50	9.75	5.50	10.63	9.90	11.30	14.87	20.50
Aug.	14.00	16.94	13.50	9.32	6.20	11.00	10.00	13.19	17.00	21.75
Sept.	14.75	17.00	13.50	9.00	7.00	10.75	9.88	13.25	18.00	20.75
Oct.	15.75	17.00	13.00	8.70	7.00	10.13	10.00	13.25	18.00	18.69
Nov.	16.00	16.39	12.13	8.50	7.00	9.30	10.50	13.63	18.00	15.90
Dec.	16.00	16.00	12.00	8.45	7.00	9.63	11.50	14.10	18.56	15.75
Aver.	*14.67*	*16.81*	*14.07*	*9.97*	*7.02*	*9.01*	*10.91*	*12.51*	*16.08*	*19.88*

No. 1 Railroad Wrought, Net Ton

	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$11.10	$13.63	$12.00	$8.50	$6.00	$4.40	$9.00	$10.60	$11.00	$16.62
Feb.	11.13	14.25	12.19	8.00	5.50	4.50	9.31	9.50	12.44	17.37
March	11.00	14.00	12.25	8.10	5.50	4.50	9.50	8.31	13.00	18.70
April	11.25	14.15	11.95	8.19	5.44	4.88	9.50	8.00	12.87	18.06
May	11.60	14.13	11.13	7.50	4.15	6.30	8.80	8.00	11.87	15.25
June	11.31	13.63	10.25	7.20	3.75	7.25	7.50	7.81	11.50	14.30
July	10.85	13.50	9.90	7.00	3.75	8.50	7.35	8.25	11.75	16.00
Aug.	11.06	13.88	9.75	7.00	4.20	9.00	7.43	9.50	13.56	19.05
Sept.	11.81	14.00	9.75	6.95	5.13	8.69	6.88	9.50	14.15	15.25
Oct.	12.60	13.70	9.19	6.75	4.63	8.12	7.00	9.50	14.25	12.69
Nov.	13.13	12.44	8.63	6.50	4.50	7.25	8.38	10.25	14.25	10.70
Dec.	13.25	12.00	8.50	6.50	4.12	7.69	9.50	11.00	14.62	10.25
Aver.	*11.67*	*13.30*	*10.46*	*7.35*	*4.72*	*6.76*	*8.34*	*9.19*	*12.94*	*15.35*

No. 1 Machinery Cast Scrap, Net Ton

	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937
Jan.	$14.50	$15.81	$13.50	$9.50	$7.75	$6.25	$9.50	$10.60	$12.00	$15.87
Feb.	14.50	16.25	13.75	9.50	7.50	6.25	9.50	10.00	12.75	16.25
March	14.50	16.00	13.75	9.50	7.20	6.25	9.50	9.38	13.10	17.40
April	14.13	16.00	13.50	9.39	7.00	7.06	9.50	9.00	12.50	17.12
May	14.00	15.39	12.88	9.00	6.50	8.45	8.90	9.00	12.00	15.25
June	13.88	14.75	12.50	9.00	6.13	8.75	7.50	9.00	12.00	15.00
July	13.50	14.50	12.00	9.00	6.00	10.63	8.05	9.30	12.12	15.75
Aug.	13.94	14.50	12.00	9.00	6.10	10.50	8.00	10.87	13.37	16.55
Sept.	14.81	14.50	11.40	8.50	6.25	10.00	8.00	11.19	13.60	14.38
Oct.	15.40	14.50	10.63	8.50	6.25	9.88	8.00	11.25	14.00	13.18
Nov.	15.50	13.63	9.36	8.50	6.25	8.60	8.25	11.50	14.00	11.65
Dec.	15.60	13.50	9.50	8.50	6.25	8.75	9.65	11.80	14.75	12.00
Aver.	*14.39*	*15.11*	*11.75*	*8.95*	*6.60*	*8.45*	*8.69*	*10.24*	*13.02*	*15.03*

*December, 1937, prices do not include quotations in Dec. 30 issue.

New Capacity

THE spectacular wave of continuous steel mill construction over the past several years has about run its course, and by the early part of 1938 every major producer will have one or more high-speed tonnage mills available for production. That there will be many more continuous wide strip mills built in late 1938 or 1939 seems at the moment very unlikely. Of course, a few smaller units may be added to round out production facilities to secure maximum efficiency, but on the average every steel mill with continuous units has enough such capacity built or building for sales departments to digest for some time to come.

A correlation of statements from all American steel makers would indicate that a total of about $225,000,000 was expended during 1937 for new construction, with the new continuous mills, together with all auxiliaries, of the United States Steel Corp., Republic and Jones & Laughlin accounting for the bulk of this figure. Expenditures during 1938 will probably not amount to much over $150,000,000, as many companies have either delayed or canceled plans for new construction due to the current business recession, Government policies or the tax situation. However, with all these restrictive factors to one side, it is unlikely that the steel industry for a number of years will equal the exceptionally heavy expenditures of 1936 and 1937, when a great mass of depression and technical obsolescence was corrected.

It is very noticeable that in 1937 the steel industry first became concerned with capacity additions, i. e., blast furnace, open hearth and bessemer construction, and this expansion is scheduled to go forward at an accelerated pace in 1938. These additions are all necessitated by the greater demands of continuous mills constructed at an earlier date or now being built. In the first half of 1937, reconstruction of blast furnaces and enlargements of open hearths elevated the national pig

BLAST FURNACES SCRAPPED IN 1937, OR TO BE SCRAPPED IN 1938:

Reading Iron Co., Keystone furnace, 110,000 tons yearly.

Youngstown Sheet & Tube Co., No. 2 Hubbard stack dismantled; capacity of 162,000 tons.

Wickwire-Spencer Steel Co., Buffalo, one stack of 150,000-ton yearly capacity.

Sloss-Sheffield Steel & Iron Co., No. 9 and 10 at Gadsden, Ala., dismantled (abandoned some years ago).

BLAST FURNACES BUILT OR IMPROVED IN 1937:

Hamilton Coke & Iron Co. (Armco), new No. 2 furnace; daily capacity of 700 tons.

Pittsburgh Steel Co., No. 1 stack hearth remodeled from 16½ ft. to 19 ft., increasing capacity from 500 to 700 tons daily.

Great Lakes Steel Corp., new stack of 1000 tons daily capacity, together with auxiliary equipment and by-product coke ovens.

Republic Steel Corp., No. 4 stack enlarged from 800 to 1000 tons daily.

BLAST FURNACES TO BE BUILT OR IMPROVED IN 1938:

Ford Motor Co., River Rouge, Mich., one new stack, rated at 1200 tons daily.

Inland Steel Co., one 25-ft. hearth stack, of 1000 tons daily capacity, together with auxiliaries and 59 Becker coke ovens.

Republic Steel Corp., No. 3 unit at Youngstown to be enlarged from 500 to 825 tons daily; No. 2 unit at Buffalo to be enlarged from 700 to 850 tons daily.

CHANGES IN BESSEMER CAPACITY:

Weirton Steel Co., Weirton, W. Va., new converter, capacity increase about 100,000 tons yearly.

Northwestern Barb Wire Co., Sterling, Ill., 30-ton-per-hr. cupola and converter for duplexing and triplexing with electric furnaces.

Ford Motor Co., River Rouge, Mich., several converters, capacity increase unknown.

OPEN HEARTHS CONSTRUCTED OR IMPROVED IN 1937:

Jones & Laughlin Steel Corp., Aliquippa, Pa., new basic unit rated at 7000 tons monthly.

American Rolling Mill Co., Middletown, Ohio, one unit enlarged from 135 to 150 tons, a second enlarged from 140 to 160 tons. At Butler, one furnace enlarged from 105 to 125 tons. Two new units planned at Kansas City, Mo.

OPEN HEARTHS TO BE BUILT OR IMPROVED IN 1938:

Inland Steel Co., Chicago, five new 150-ton basic units.

Gulf States Steel Co., Gadsden, Ala., two new 125-ton basic units.

Great Lakes Steel Corp., four new 200-ton basic units.

Carnegie-Illinois Steel Corp., Edgar Thomson works, 16 100-ton basic units to be enlarged to 150 tons (this added capacity will supply the new Irvin works).

Ford Motor Co., River Rouge, Mich., three furnaces to be enlarged, each from 5000 tons to 9000 tons monthly.

Laclede Steel Co., St. Louis, two furnaces to be rebuilt and enlarged, capacity increased about 30,000 tons yearly.

ELECTRIC FURNACES INSTALLED IN 1937:

Driver-Harris Co., 200 kw. of Ajax-Northrup equipment, or about 1400 tons yearly capacity.

Other Ajax-Northrup installations total 525 kw. mostly for research purposes or non-ferrous melting; about 1550 kw. installed for heat treating, forging, etc.

Pittsburgh Lectromelt Corp., installed 44,500 kw. capacity (21 furnaces), for the production of stainless and other high-grade alloys.

Greene Electric Furnace Co., Seattle, Wash., five small furnaces, totaling 1700 kva.

Northwestern Barb Wire Co., Sterling, Ill., two furnaces rebuilt, enlarging capacity from 300 tons to 600 tons daily.

Ludlum Steel Co., one 15-ton Heroult unit, rated at 15,000 tons yearly. One 500-lb. Rennerfeldt furnace also placed in production.

Allegheny Steel Co., one 25-ton unit, rated at 36,000 tons yearly.

HOT MILLS COMPLETED IN 1937:

Republic Steel Corp., Cleveland, one 98-in., 10-stand, 4-high strip-sheet mill, rated at 700,000 tons yearly.

Rustless Iron & Steel Co., Baltimore, 12-in., 3-high, 7-stand merchant mill, rated at 6000 tons yearly.

Carnegie-Illinois Steel Corp., Gary, one 3-high, 84-in. finishing mill with 2-high roughing stand.

Jones & Laughlin Steel Corp., Pittsburgh, one 96-in., 4-high, 10-stand continuous strip-sheet mill, rated at 700,000 tons yearly.

Bethlehem Steel Co., Sparrows Point, Md., one 56-in., 6-stand, 4-high strip-sheet mill, rated at 600,000 tons yearly.

Youngstown Sheet & Tube Co., reversing mill for rounds, rated at 420,000 tons yearly.

Bethlehem Steel Co., Sparrows Point, Md., 4-stand continuous rod and bar mill, capacity of 240,000 tons yearly.

Kilby Car & Foundry Co., Anniston, Ala., one 18-in. bar mill, capacity of 20,000 tons yearly.

Northwestern Barb Wire Co., Sterling, Ill., 3-high, 18-in. blooming mill widened to 22-in., capacity increased by 21,000 tons yearly.

American Steel & Wire Co., Joliet, Ill., two 19-stand, 2-strand, continuous rod mills, rated at 220,000 tons yearly.

HOT MILLS TO BE COMPLETED IN 1938:

Inland Steel Co., Chicago, one 44-in. strip mill of 400,000 tons yearly capacity.

Carnegie-Illinois Steel Corp., Irvin works, one 100-in. slabber (Edgar Thomson), followed by 10-stand, 4-high, 80-in. tandem unit, rated at 800,000 tons yearly.

Tennessee Coal, Iron & Railroad Co., Birmingham, one 48-in. reversing plate mill, followed by 6-stand, 4-high, 48-in. continuous finishing mill, rated at 400,000 tons yearly.

Columbia Steel Co., 24-in. edging mill, scale breaker and additions to 36-in. and 22-in. mills.

Ford Motor Co., River Rouge, Mich., widening of continuous unit from 58 to 66 in., increasing capacity by 75,000 tons yearly.

Northwestern Barb Wire Co., Sterling, Ill., one 5-stand, 3-high, 12-in. merchant mill, with a capacity of 15,000 tons yearly.

Follansbee Brothers Co., Toronto, Ohio, one 43-in. continuous mill, rated at 265,000 tons yearly (if financing is secured).

Republic Steel Corp., Gulfsteel division, Gadsden, Ala., sheet mill revamping to lift capacity by 75,000 tons yearly.

Otis Steel Co., Cleveland, continuous unit to be widened from 72 in. to 77 in.

COLD MILLS BUILT OR INSTALLED IN 1937:

Republic Steel Corp., Cleveland, one 98-in., 10-stand, 4-high strip-sheet mill, rated at 650,000 tons yearly.

Republic Steel Corp., Niles, Ohio, one new 4-stand, 4-high continuous unit; has produced at the rate of 190,000 tons yearly.

Carnegie-Illinois Steel Corp., Gary, Ind., 42-in., 5-stand, 4-high strip unit, rated at 100,000 tons yearly.

Jones & Laughlin Steel Corp., Pittsburgh, one 93-in., 3-stand tandem mill; 93-in., 4-high temper pass unit and a 55-in., 2-high skin pass mill, with combined annual capacity of 500,000 tons.

Bethlehem Steel Co., Sparrows Point, Md., 56-in., 5-stand, 4-high strip mill, rated at 150,000 tons yearly.

Detroit Steel Corp., 24-in., 4-high reversing mill, rated at 1500 tons yearly.

Youngstown Sheet & Tube Co., Youngstown, Ohio, 4-high strip mill, rated at 180,000 tons yearly.

Thomas Steel Co., Warren, Ohio, one 10½ x 26 x 24 in. Steckel mill, rated at about 8000 tons yearly.

Reeves Steel & Mfg. Co., Dover, Ohio, three semi-continuous finishing, one continuous 3-high roughing and two semi-continuous roughing mills, with a total capacity of 70,000 tons annually (nine old sheet hand mills dismantled).

Wheeling Steel Corp., one 42-in., 5-stand, 4-high cold reducing tin mill with auxiliaries; yearly capacity of 120,000 tons.

Wallingford Steel Co., Wallingford, Conn., new 13 x 16 in. pinch pass mill capacity of 2000 tons yearly.

McLouth Steel Corp., Detroit, one 4-high, 10 x 24 x 28 in. unit of 4500 tons monthly capacity, and one 2-high, 18 x 26 in. skin pass mill of 4500 tons monthly capacity.

John A. Roebling's Sons Co., Trenton, N. J., one 6½-in., 3-high, ring-type strip mill; capacity of 1500 tons yearly.

Cold Metal Process Co., one 26-in., one 18-in., and one 7½-in. Steckel mill, rated at 12,000, 12,000 and 4000 tons yearly respectively.

International Nickel Co., Huntington, W. Va., one 20-in. Steckel mill, rated at 6000 tons yearly.

Barium Stainless Steel Corp., Canton, Ohio, one 20-in. Steckel mill, rated at 6000 tons yearly.

COLD MILLS TO BE BUILT OR INSTALLED IN 1938:

Carnegie-Illinois Steel Corp., Irvin works, one 3-stand, 84-in., tandem unit, rated at 250,000 tons; one 5-stand, 42-in. tandem unit rated at 100,000 tons; and one single-stand, 54-in. reversing mill rated at 100,000 tons.

Tennessee Coal, Iron & Railroad Co., Birmingham, two 5-stand, 4-high, 42-in. tandem units, rated at 200,000 tons.

American Steel & Wire Co., Cleveland, eight to ten reversing mills, 16 to 26 in. wide, with total capacity of 300,000 tons.

Otis Steel Co., Cleveland, continuous cold mill to be widened, lifting capacity by 50 per cent

Acme Steel Co., Chicago, one 12 x 33 x 29 in., 4-high reversing cold mill, and one 18 x 29-in., 2-high cold mill, capacity of 50,000 tons yearly.

Cold Metal Process Co., Youngstown, Ohio, one 7½-in. Steckel mill, rated at 4000 tons yearly. Two other similar mills are being built, but buyers' names are withheld.

Allegheny Steel Co., one 22-in. Steckel mill, rated at 12,000 tons yearly.

iron capacity from 49,604,737 tons to 49,819,737 tons, and increased open hearth capacity 289,500 tons to 69,244,694 tons. A glance at the accompanying table, which lists the total of 11 large new basic units scheduled for construction and 21 units scheduled for enlarging, would indicate that the official open hearth capacity of the country will go through another sizable advance by the middle of 1938. Likewise, the new Ford stack, the new Inland stack and the enlargement of several Republic blast furnaces, and technical improvements on numerous U. S. Steel stacks will serve to add considerable new pig iron capacity during the same period.

The bessemer converter, which was almost forced out of the picture by the open hearth during the past three decades, is undergoing a mild revival, and from certain technical work taking place it seems that the converter may be expected to be increasingly favored in a moderate way in succeeding years. During 1937 Weirton Steel Co. added a modern converter, thereby lifting its output by 10 per cent, and Ford plans to build two or more converters during 1938. The last previous new bessemer construction took place in 1930, when Jones & Laughlin added several units, and after that it is necessary to go back to 1922 to find other new bessemer construction.

Continuous cold mills added during the year and scheduled for completion during 1938 are for the most part designed to handle the coiled steel turned out by the new continuous hot strip-sheet mills. It is likely that in 1939 installations of cold mills, particularly the continuous type, will fall off, although construction of the smaller reversing units may hold up to a fairly high level. Aside from finished steel products such as sheets, strip and tin plate, the industry during 1937 placed the most emphasis on modern types of continuous rod mills, with Bethlehem and U. S. Steel adding large units. Several smaller companies placed in operation a considerable volume of new wire drawing capacity.

Electric furnace installations during 1937 about equaled the volume of 1936. Total new capacity aggregated in the neighborhood of 70,000 kw., and from the way new orders have been coming in for installation in 1938 it appears that furnace builders will suffer little reduction in activity. All furnace makers in this country received some attractive orders for delivery abroad in 1937, but this equipment is not designated in the accompanying table.

THE IRON AGE Weekly Index of Capital Goods Activity

(1925-27 = 100)

Week ended Jan. 1	54.5	Same week 1935	56.4
Preceding week	59.6*	Same week 1934	50.3
Same week last month	60.5	Same week 1933	39.6
Same week 1937	100.2	Same week 1932	52.3
Same week 1936	73.2	Same week 1931	64.7
	Same week 1929	118.7	

* Revised.

LED by a heavy decline in the automobile series, THE IRON AGE index of capital goods activity slipped from 59.6, the revised index of the week ended Dec. 25, 1937, to 54.5 for the week ended Jan. 1. The sharp recession in automobile assemblies lowered the index number of this component 18.8 points to 57.3 per cent of the 1929 average. Other losses were recorded in the steel series, which declined 2.8 points, industrial activity and shipments in the Pittsburgh area, which dropped 1.0 point, and the lumber carloadings series which was off 0.7 points.

The weighted index for December, 1937, was 59.2, the lowest level touched since October, 1935, and 5.7 points below the index of November, 1937. The average monthly index in the past year was 86.2, a rise of 4.9 points above the 1936 figure. In contrast to this gain, the year 1936 was 20.4 points over the previous year, and 1935 was 8.9 points above 1934. The decline in the monthly index numbers in 1937 from a high of 102.8 in August, to a low of 59.2 in December, was the sharpest experienced in any year that the records of THE IRON AGE cover.

	Latest Week	Change from Preceding Week
Steel production (per cent of capacity)	20.0	—3.5
Automobile production (number of cars and trucks)	49,550	—17,680
Railroad loadings of forest products (number of cars)	20,160	—3,851
Pittsburgh industrial production and shipments (index number)	52.8	—1.3
Construction contracts awarded (total value)	$44,989,000	—$485,000

Components of The Index (1) Steel Ingot Production Rate, from THE IRON AGE; (2) Automobile Production, from Ward's Automotive Reports; (3) Revenue Freight Carloadings of Forest Products, from Association of American Railroads; (4) Industrial Productive Activity in Pittsburgh District from Bureau of Business Research of University of Pittsburgh; (5) Heavy Construction Contract Awards, from *Engineering News-Record*.

NON-FERROUS

. . . All domestic markets very quiet; prices unchanged.

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. . . Low prices spur export demand.

NEW YORK, Jan. 3. — The anticipated holiday dullness has ruled in all non-ferrous markets during the past week and prices are unchanged from the preceding week. Domestic copper sales for the week ended Dec. 30 amounted to 2609 tons, bringing the month's total to 24,483 tons. The smelters' Connecticut Valley quotation of 10.125c. per lb. for electrolytic metal remains unchanged, while producers continue to quote on the 11c. basis. Export prices dropped to 9.70c. per lb., c.i.f., usual Continental base ports, on Thursday morning and about 6000 tons were reported sold at that price. In the afternoon the price advanced to 9.81c. and buying dropped back to normal.

Lead

With the total absence of forward buying, the opening of the February books today became a mere formality. Although sales over the past month have been very light, the fact that January's requirements are estimated to be only 33 per cent covered indicates that possibilities of a substantial spurt in buying activity within the next two weeks. Prices over the past week held unchanged at the 4.75c. per lb., New York, level.

Zinc

The market has been featureless and inactice all week, with prime Western metal still quoted at 5.35c. per lb., New York. Deliveries to consumers, which have been constantly decreasing over the past two months, are expected to show a slight rise after the inventory period, but the low rate of galvanizing operations makes it probable that the advance will be very small. Today's London quotation of 3.29c. per lb. is 14 points below the level of a week ago.

Tin

The year ended with the market in the doldrums and prices drifting around the year's lowest level. Today's Straits tin quotation of 41.125c. per lb., New York, is 0.87c. below the price of a week ago. Domestic tin deliveries in December were 5020 tons, as compared with 5195 tons in November and 8210 tons in October. The 12-month total for 1937 is 83,665 tons, while in 1936 it was 74,005 tons. The London market has also been very dull, and on first call this morning cash standards were quoted at £181 5s.

December Average Prices

The average prices of the major non-ferrous metals in December, based on the daily quotations appearing in THE IRON AGE, were as follows:

Electrolytic copper, Connecticut Valley	10.235c.
Lake copper, Eastern delivery	11.125c.
Straits tin, spot, New York	42.963c.
Zinc, East St. Louis	5.010c.
Zinc, New York	5.360c.
Lead, St. Louis	4.725c.
Lead, New York	4.875c.

Railroad Demands Lower Price Level

PORT HURON, Mich., Jan. 4.— Grand Trunk Railroad car shop officials announced Monday that they would lay off 185 employees until commodity prices are stabilized at a lower level. "Our 1938 budget provides for the expenditure here of $1,575,000 for reconstruction of 500 steel hopper cars and 500 automobile cars," Harry G. Love, shop superintendent said, "but we will postpone the program until the price of steel and other commodities drop."

The Week's Prices. Cents Per Pound for Early Delivery

	Dec. 28	Dec. 29	Dec. 30	Dec. 31	Jan. 3
Electrolytic copper, Conn.*	10.125	10.125	10.125	10.125	10.125
Lake copper, N. Y.	11.125	11.125	11.125	11.125	11.125
Straits tin, spot, New York	41.125	41.125	41.375	41.00	41.125
Zinc, East St. Louis	5.00	5.00	5.00	5.00	5.00
Zinc, New York	5.35	5.35	5.35	5.35	5.35
Lead, St. Louis	4.60	4.60	4.60	4.60	4.60
Lead, New York	4.75	4.75	4.75	4.75	4.75

*Delivered Connecticut Valley; price ¼c. lower delivered in New York.
Aluminum, virgin, 99 per cent plus 20.00c.-21.00c. a lb., delivered.
Aluminum No. 12 remelt No. 2 standard, in carloads, 19.00c. to 19.50c. a lb., delivered.
Nickel, electrolytic, 35c. to 36c. a lb. base refinery, in lots of 2 tons or more.
Antimony, Asiatic, 15.00c. a lb., prompt, f.o.b., New York.
Antimony, American, 13.75c. per lb., prompt shipment, New York.
Quicksilver, $80.00 to $81.00 per flask of 76 lb.
Brass ingots, commercial 85-5-5-5, 11.25c. a lb., less carload, delivered in Middle West ¼c. a lb. is added on orders for less than 40,000 lb.

From New York Warehouse

Delivered Prices, Base per Lb.

Tin, Straits pig	42.50c. to 43.50c.
Tin, bar	44.50c. to 45.50c.
Copper, Lake	12.00c. to 12.50c.
Copper, electrolytic	12.00c. to 12.50c.
Copper, castings	11.50c. to 11.75c.
*Copper sheets, hot-rolled	19.125c.
*High brass sheets.	17.375c.
*Seamless brass tubes	20.125c.
*Seamless copper tubes	19.875c.
*Brass rods	13.375c.
Zinc, slabs	6.75c. to 7.75c.
Zinc, sheets (No. 9), casks, 1200 lb. and over	12.00c.
Lead, American pig.	5.75c. to 6.75c.
Lead, bar	7.00c. to 8.00c.
Lead, sheets, cut	8.50c.
Antimony, Asiatic	16.00c. to 17.00c.
Alum., virgin, 99 per cent plus	22.50c. to 24.00c.
Alum., No. 1 for remelting, 98 to 99 per cent	19.50c. to 21.00c.
Solder, ½ and ½	30.00c. to 32.00c.
Babbitt metal, commercial grade	20.00c. to 60.00c.

*These prices, which are also for delivery from Chicago and Cleveland warehouses, are quoted with 25 per cent allowed off for extras, except copper sheets and brass rods, on which allowance is 40 per cent.

From Cleveland Warehouse

Delivered Prices per Lb.

Tin, Straits pig	45.375c.
Tin, bar	47.375c.
Copper, Lake	12.00c. to 12.25c.
Copper, electrolytic	11.00c. to 12.15c.
Copper, castings	10.50c. to 10.75c.
Zinc, slabs	8.25c. to 8.50c.
Lead, American pig.	5.25c. to 5.50c.
Lead, bar	8.75c.
Antimony, Asiatic	17.25c. to 17.75c.
Babbitt metal, medium grade	18.00c.
Babbitt metal, high grade	60.00c.
Solder, ½ and ½	25.75c.

Old Metals, Per Lb., New York

Buying prices are paid by dealers for miscellaneous lots from smaller accumulators and selling prices are those charged to consumers after the metal has been prepared for their uses. (All prices are nominal.)

	Dealers' Buying Prices	Dealers' Selling Prices
Copper, hvy. crucible	7.875c.	8.625c.
Copper, hvy. and wire	7.25c.	7.75c.
Copper, light and bottoms	6.25c.	6.50c.
Brass, heavy	4.375c.	5.00c.
Brass, light	3.375c.	4.125c.
Hvy. machine composition	6.875c.	7.375c.
No. 1 yel. brass turnings	4.75c.	5.25c.
No. 1 red brass or compos. turnings	6.50c.	7.00c.
Lead, heavy	4.00c.	4.375c.
Cast aluminum	10.625c.	11.75c.
Sheet aluminum	12.00c.	13.50c.
Zinc	2.875c.	3.125c.

THIS WEEK ON THE ASSEMBLY LINE

. . . Automobile industry retrenching rapidly as Sloan admits recession is serious.

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. . . Ford and Chevrolet in "camera finish" in sales competition.

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. . . Production slumps to 49,550 compared with 79,538 a year ago.

DETROIT, Jan. 4.—The announcement of General Motors Corp. President William S. Knudsen last week that 30,000 workers would be laid off means that since the first of October 60,000 have been dropped from G.M. payrolls and is an indication of the rapidity with which the automobile business is retrenching now that it is certain that "we are in a recession in fact—important in both scope and magnitude," as Alfred P. Sloan, Jr., said in his New Year's statement.

Aside from making his official statement on the lay-off, which reduces the G.M. payroll from the year's peak of 270,000 to 205,000 men, Mr. Knudsen in an interview which followed revealed some interesting and important statistics. The payroll now will be $24,000,000 compared with a peak payroll in 1937 of $37,000,000 last spring, an all-time record for the corporation. The corporation itself, he said, has inventories which are $65,000,000 greater than a year ago. The industry's dealers have on hand a total of 600,000 used cars, which is nearly 160,000 more than a year ago. Dealers also have 60,000 more new cars than they had last year, so that the over-all picture is one of a serious overstocking. In this, Mr. Knudsen saw the immediate cause for the lay-offs, since the failure to sell the used cars plugged up the market for new automobiles. But the primary reason for the recession, he said, is "the price level rose too fast in the spring of 1937. We did not do anything in that direction ourselves until costs had gone up. By that time, when we increased prices, purchasing power had already dropped off."

Production for January in General Motors will be off about 45 per cent from the norm of approximately 200,000 cars. As for the year's total sales, Mr. Knudsen revealed that in his opinion a 20 per cent reduction in volume was an optimistic guess. How much more seriously production will be affected, he did not venture.

Price Reductions Expected

Informal opinion throughout the industry indicates that price reductions are forthcoming very soon, but when Mr. Knudsen was asked about this he said, "I can't tell you anything about that. So far there isn't any ground that I can see for such action. The real facts are that the cost went over about 13½ per cent and the prices so far as General Motors is concerned were increased about 8½ per cent. We figured on volume making up the difference and we evidently figured wrong to date."

C. E. Wilson, General Motors vice-president, pointed out that Canadian production and sales are equal to the forecast made at the beginning of the production year.

The relative position of the Big Three cars — Ford, Chevrolet and Plymouth—is always of interest, probably because the combined activities of these three are indicative of the general condition of the automobile business. A "camera finish" in sales competition is revealed by registration figures on these three. Chevrolet, hampered by strikes in the early part of the year, was away to such a slow start that in July Ford led the field by 106,000 units. Since then Chevrolet has struggled to close the gap and at the year's close was approximately 8000 behind.

Production during the Christmas week slumped sharply, although Chevrolet maintained its 18,000 of the previous week and Ford stepped up from 20,000 units to 23,000. Plymouth was closed entirely, and for the current week also has a prospect of producing no cars at all. The industry produced a total of 49,550 cars and trucks, compared with 67,230 the previous week and 79,538 a year ago, according to Ward's Automotive Reports.

In view of the upset conditions in the automobile business, the announcement that K. T. Keller, president of Chrysler Corp., will hold a meeting of about 1000 Chrysler representatives is significant. The purpose of this meeting, Mr. Keller stated, is to review with the field organization general business conditions; to discuss policies in reference to the sale of the corporation's products and to discuss relations between the factory and dealers.

Hudson Begins To Make New Car In Lowest Price Field

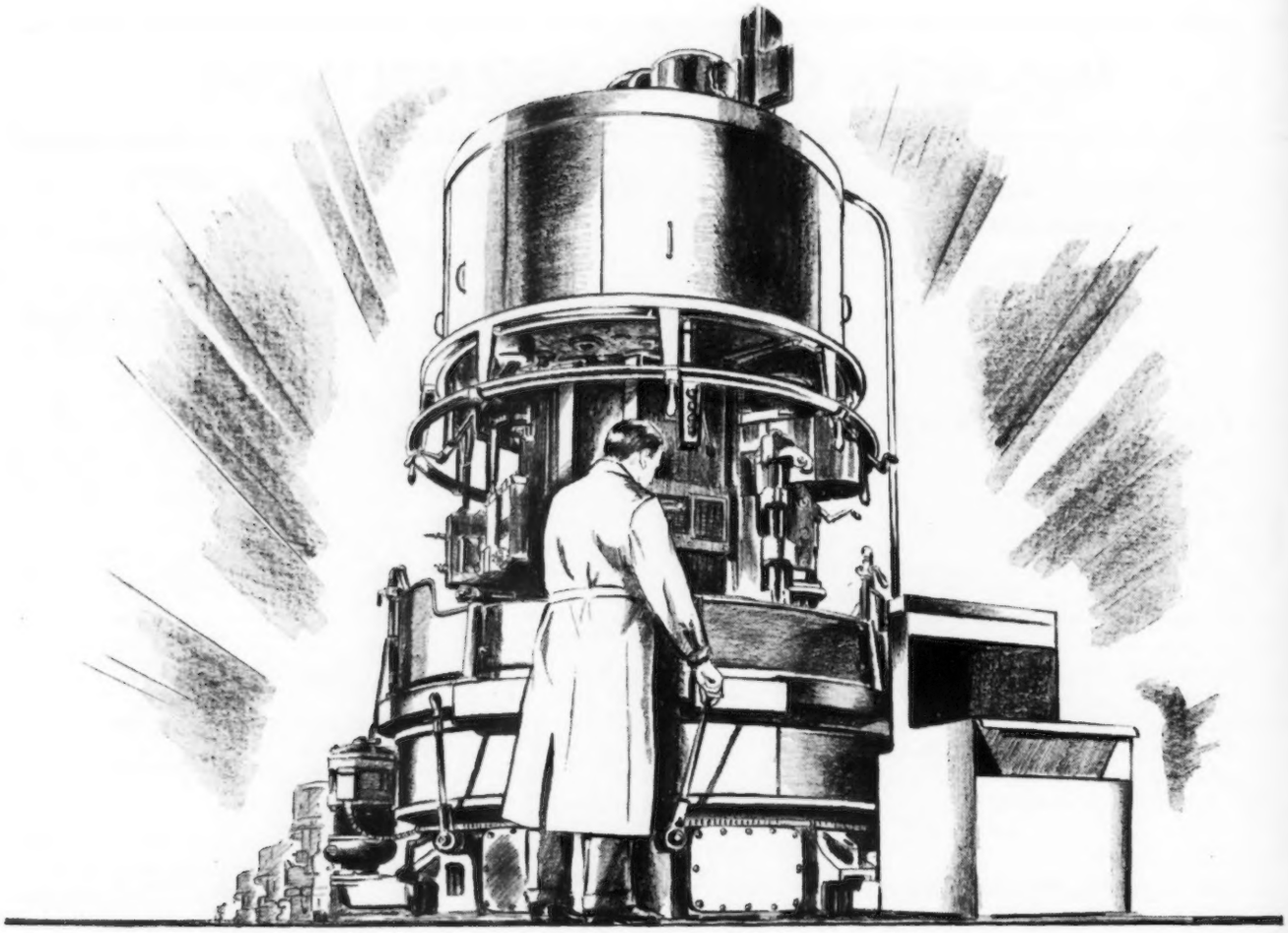
DETROIT, Jan. 4.—Hudson Motor Car Co. will double its working force and step up to full time production immediately starting production this week on a new car in the lowest price field it was announced Tuesday by A. E. Barit, president.

As part of a plan to put men and money back to work the firm will rehire 6000 men making a total of 12,000 on the payroll and will expend an estimated $11,000,000 for tools and production materials.

The factory payroll will be increased by $1,250,000 per month. Speaking to more than 100 of the country's leading publishers and editors, Mr. Barit emphasized the significance of the move into the lowest price field, asserting that the expanded activity and employment was more important than the preview of the new car. Barit said "it has become increasingly clear to us that with business slowing down as it has recently we were in a position to do more than announce a new automobile—we could in a way set the pace in the matter of putting men and money back to work.

"The automobile industry was credited a few years ago with leading the way toward an upward trend for business. It seems possible to expect it to do something about leading the way out of the recession."

The car, it is understood, will have a 112 in. wheel base.



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BRIDGEPORT • CONNECTICUT

. . . .SUMMARY OF THE WEEK. . . .

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. . . New Year starts with ingot output at 25½%, a slight gain.

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. . . Pig iron off 28.7% in December; year's total 36,599,836 tons.

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. . . Outlook for immediate future uncertain owing to Administration policies.

THE New Year starts with steel ingot production at 25½ per cent, a moderate gain over last week, but with prospects still shrouded in uncertainty. Whatever hopes have been entertained for at least a fair recovery this month from the low operating rate of December must be tempered in view of the recalcitrant attitude of the Federal Administration toward business. The effect of recent speeches has been discouragement at a time when the opposite influence was sorely needed.

Best gains in operations were in the Pittsburgh district, where this week's rate is 28 per cent against 19 per cent last week; in the Wheeling-Weirton district, with a rise from 22 to 44 per cent; in the Cleveland-Lorain area, where the average is 25 per cent against 14 per cent at the year end; at Youngstown, which has gone to 22 per cent from 15 per cent. Reflecting the small amount of automobile buying, the Detroit ingot rate is 22 per cent, which is entirely Ford production.

Pig iron production in December, at 1,478,843 gross tons, was 28.7 per cent below that of November based on the daily rate of 47,705 tons, and the lowest since January, 1935. The year's output was 36,599,836 tons, a gain of 19.5 per cent over the 30,618,797 tons in 1936. There was a loss of 20 furnaces, leaving 93 in blast on Jan. 1.

WITH a few exceptions, the volume of orders for steel products in December fell below that of November. Although inventories of many consumers and distributers have been considerably reduced in the past few months, no great amount of replenishment buying is expected immediately owing to the uncertainties in the general business picture.

Railroad buying, though much below normal for this time of year, is nevertheless one of the current bright spots. The Chesapeake & Ohio has allocated 27,500 tons of rails, of which 14,700 tons will be furnished by Carnegie-Illinois, 9600 tons by Inland and 3200 tons by Bethlehem. In addition, the Nickel Plate and Pere Marquette will award about 12,350 tons of rails to domestic mills and the Pere Marquette will buy 3380 tons in Canada. The Tennessee Coal, Iron & Railroad Co. has recently accumulated total bookings of 120,000 tons of rails, and some additional business is expected.

The extent of the activity in the automobile industry this month is so uncertain that the steel industry is not counting very much on business from that source.

In the construction field there is almost a stalemate, which many believe to be due to attacks on prices by Administration spokesmen. Structural steel lettings in the week were 11,700 tons, nearly half of which was in two public jobs, a bridge over the Mississippi River at La Crosse, Wis., taking 3300 tons, and a high school building in Milwaukee, calling for 2210 tons. The outstanding private project awarded was a power plant at Lansing, Mich., requiring 1525 tons. Less than 9000 tons of new work came into the market. A bridge at Hennepin, Ill., 2000 tons, is the largest new project.

A branch of the construction industry whose prospects are promising for early expansion is shipbuilding. A Standard Oil unit will award 12 tank ships, requiring a total of 60,000 tons of steel, to four shipyards. In addition, the Navy is expected to place a contract shortly for two tenders that will require about 20,000 tons of steel. On top of these jobs will come the 12 ships for the Maritime Commission, on which bids are to be taken early in February.

Industries in the metalworking fields for which the outlook for the year as a whole has not been materially dimmed by recent events are shipbuilding, airplane manufacture, farm implements and tractor manufacture, can manufacture and oil well drilling and pipe line construction.

Scrap prices are up this week at Philadelphia and Chicago, but are marking time at Pittsburgh pending the outcome of bids on railroad lists. A 50c. rise at Philadelphia was brought about mainly by purchases for export. THE IRON AGE composite price has risen to $14, fifth consecutive weekly gain. Scrap exports for 11 months are officially reported at 3,776,123 gross tons, assuring a record-breaking total for the year of 4,000,000 tons or more.

Iron and steel exports of 3,165,343 tons in the same period indicate about 3,500,000 tons for the year, highest since 1920. Tin plate shipments of 322,975 tons are the largest on record.

A Comparison of Prices

Market Prices at Date, and One Week, One Month, and One Year Previous
Advances Over Past Week in Heavy Type, Declines in Italics

Rails and Semi-finished Steel

Per Gross Ton:	Jan. 4, 1938	Dec. 28, 1937	Dec. 7, 1937	Jan. 4, 1937
Rails, heavy, at mill	$42.50	$42.50	$42.50	$39.00
Light rails, Pittsburgh	43.00	43.00	43.00	38.00
Rerolling billets, Pittsburgh	37.00	37.00	37.00	34.00
Sheet bars, Pittsburgh	37.00	37.00	37.00	34.00
Slabs, Pittsburgh	37.00	37.00	37.00	34.00
Forging billets, Pittsburgh	43.00	43.00	43.00	40.00
Wire rods, Nos. 4 and 5, P'gh	47.00	47.00	47.00	43.00
	Cents	Cents	Cents	Cents
Skelp, grvd. steel, P'gh, lb.	2.10	2.10	2.10	1.80

Finished Steel

Per Lb.:	Cents	Cents	Cents	Cents
Bars, Pittsburgh	2.45	2.45	2.45	2.20
Bars, Chicago	2.50	2.50	2.50	2.25
Bars, Cleveland	2.50	2.50	2.50	2.25
Bars, New York	2.79	2.79	2.75	2.55
Plates, Pittsburgh	2.25	2.25	2.25	2.05
Plates, Chicago	2.30	2.30	2.30	2.10
Plates, New York	2.54	2.54	2.54	2.34
Structural shapes, Pittsburgh	2.25	2.25	2.25	2.05
Structural shapes, Chicago	2.30	2.30	2.30	2.10
Structural shapes, New York	2.5125	2.5125	2.5125	2.31½
Cold-finished bars, Pittsburgh	2.90	2.90	2.90	2.55
Hot-rolled strips, Pittsburgh	2.40	2.40	2.40	2.15
Cold-rolled strips, Pittsburgh	3.20	3.20	3.20	2.85
Hot-rolled annealed sheets, No. 24, Pittsburgh	3.15	3.15	3.15	2.80
Hot-rolled annealed sheets, No. 24, Gary	3.25	3.25	3.25	2.90
Sheets, galv., No. 24, P'gh	3.80	3.80	3.80	3.40
Sheets, galv., No. 24, Gary	3.90	3.90	3.90	3.50
Hot-rolled sheets, No. 10, Pittsburgh	2.40	2.40	2.40	2.15
Hot-rolled sheets, No. 10, Gary	2.50	2.50	2.50	2.25
Cold-rolled sheets, No. 20, Pittsburgh	3.55	3.55	3.55	3.25
Cold-rolled sheets, No. 20, Gary	3.65	3.65	3.65	3.35
Wire nails, Pittsburgh	2.75	2.75	2.75	2.25
Wire nails, Chicago dist. mill	2.80	2.80	2.80	2.30
Plain wire, Pittsburgh	2.90	2.90	2.90	2.60
Plain wire, Chicago dist. mill	2.95	2.95	2.95	2.65
Barbed wire, galv., Pittsburgh	3.40	3.40	3.40	2.75
Barbed wire, galv., Chicago dist. mill	3.45	3.45	3.45	2.80
Tin plate, 100-lb. box, P'gh	$5.35	$5.35	$5.35	$4.85

On export business there are frequent variations from the above prices. Also in domestic business, there is at times a range of prices on various products, as shown in our detailed price tables.

Pig Iron

Per Gross Ton:	Jan. 4, 1938	Dec. 28, 1937	Dec. 7, 1937	Jan. 4, 1937
No. 2 fdy., Philadelphia	$25.76	$25.76	$25.76	$22.76
No. 2, Valley furnace	24.00	24.00	24.00	21.00
No. 2, Southern Cin'ti	23.89	23.89	23.89	20.69
No. 2, Birmingham†	20.38	20.38	20.38	17.38
No. 2, foundry, Chicago*	24.00	24.00	24.00	21.00
Basic, del'd eastern Pa.	25.26	25.26	25.26	22.26
Basic, Valley furnace	23.50	23.50	23.50	20.50
Malleable, Chicago*	24.00	24.00	24.00	21.00
Malleable, Valley	24.00	24.00	24.00	21.00
L. S. charcoal, Chicago	30.24	30.24	30.24	26.54
Ferromanganese, seab'd, carlots	102.50	102.50	102.50	80.00

† This quotation is subject to a deduction of 38c. a ton for phosphorus content of 0.70 per cent or higher.
*The switching charge for delivery to foundries in the Chicago district is 60c. per ton.

Scrap

Per Gross Ton:				
Heavy melting steel, P'gh	$14.25	$14.25	$13.25	$19.25
Heavy melting steel, Phila.	**14.75**	14.25	14.25	16.75
Heavy melting steel, Ch'go	**13.00**	12.75	11.75	17.75
Carwheels, Chicago	15.50	15.50	14.50	18.00
Carwheels, Philadelphia	16.25	16.25	16.25	17.25
No. 1 cast, Pittsburgh	16.25	16.25	16.25	17.25
No. 1 cast, Philadelphia	16.75	16.75	16.25	17.25
No. 1 cast, Ch'go (net ton)	12.50	12.50	11.50	15.50
No. 1 RR. wrot., Phila.	16.25	16.25	16.25	15.75
No. 1 RR. wrot., Ch'go (net)	10.75	10.75	9.75	16.50

Coke, Connellsville

Per Net Ton at Oven:				
Furnace coke, prompt	$4.00	$4.00	$4.00	$4.00
Foundry coke, prompt	5.00	5.00	5.00	4.50

Metals

Per Lb. to Large Buyers:	Jan. 3 Cents	Dec. 27 Cents	Cents	Cents
Electrolytic copper, Conn.	10.125	10.125	10.50	12.00
Lake copper, New York	11.125	11.125	11.125	12.12½
Tin (Straits), New York		42.00	44.50	51.35
Zinc, East St. Louis	5.00	5.00	5.00	5.45
Zinc, New York	5.35	5.35	5.35	5.82½
Lead, St. Louis	4.60	4.60	4.85	5.85
Lead, New York	4.75	4.75	5.00	6.00
Antimony (Asiatic), N. Y.	15.00	15.00	14.50	13.75

The Iron Age Composite Prices

	Finished Steel	Pig Iron	Steel Scrap
Jan. 4, 1938	2.605c. a Lb.	$23.25 a Gross Ton	$14.00 a Gross Ton
One week ago	2.605c.	23.25	13.75
One month ago	2.605c.	23.25	13.08
One year ago	2.330c.	20.25	17.92

Based on steel bars, beams, tank plates, wire, rails, black pipe, sheets and hot-rolled strip. These products represent 85 per cent of the United States output.

Based on average of basic iron at Valley furnace and foundry irons at Chicago, Philadelphia, Buffalo, Valley and Southern iron at Cincinnati.

Based on No. 1 heavy melting steel quotations at Pittsburgh, Philadelphia and Chicago.

	Finished Steel HIGH	Finished Steel LOW	Pig Iron HIGH	Pig Iron LOW	Steel Scrap HIGH	Steel Scrap LOW
1937	2.605c., Mar. 9	2.330c., Mar. 2	$23.25, Mar. 9	$20.25, Feb. 16	$21.92, Mar. 30	$12.92, Nov. 16
1936	2.330c., Dec. 28	2.084c., Mar. 10	19.73, Nov. 24	18.73, Aug. 11	17.75, Dec. 21	12.67, June 9
1935	2.130c., Oct. 1	2.124c., Jan. 8	18.84, Nov. 5	17.83, May 14	13.42, Dec. 10	10.33, April 23
1934	2.199c., Apr. 24	2.008c., Jan. 2	17.90, May 1	16.90, Jan. 27	13.00, Mar. 13	9.50, Sept. 25
1933	2.015c., Oct. 3	1.867c., Apr. 18	16.90, Dec. 5	13.56, Jan. 3	12.25, Aug. 8	6.75, Jan. 3
1932	1.977c., Oct. 4	1.926c., Feb. 2	14.81, Jan. 5	13.56, Dec. 6	8.50, Jan. 12	6.43, July 5
1931	2.037c., Jan. 13	1.945c., Dec. 29	15.90, Jan. 6	14.79, Dec. 15	11.33, Jan. 6	8.50, Dec. 29
1930	2.273c., Jan. 7	2.018c., Dec. 9	18.21, Jan. 7	15.90, Dec. 16	15.00, Feb. 18	11.25, Dec. 9
1929	2.317c., Apr. 2	2.273c., Oct. 29	18.71, May 14	18.21, Dec. 17	17.58, Jan. 29	14.08, Dec. 3
1928	2.286c., Dec. 11	2.217c., July 17	18.59, Nov. 27	17.04, July 24	16.50, Dec. 31	13.08, July 2
1927	2.402c., Jan. 4	2.212c., Nov. 1	19.71, Jan. 4	17.54, Nov. 1	15.25, Jan. 11	13.08, Nov. 22

WASHINGTON

Competition In Steel "Vanishes," Jackson Charges

WASHINGTON, Jan. 4.—Assistant Attorney General Robert H. Jackson, head of the Justice Department's anti-trust division, has indicated to Congress that competition in iron, steel and other industries has declined to "the vanishing point."

Mr. Jackson, currently the Administration's most zealous anti-big-business addict and incidentally the Rooseveltian choice for the White House in 1940, so some people think, wrote in the Justice Department's annual report to Congress that bids for Government purchases are identical "to an increasing extent in widely separated areas."

Cites Identical Bids

In substantiation of the perennial charge of "monopoly" made by key New Dealers, the Assistant Attorney General drew from the Government's experience as a buyer in the open market and listed a number of items, headed by iron and steel products, on which he said the Government had received identical bids. The list included sheets, plates, bars and shapes as well as structural steel; brass and bronze products; cement; machinery and allied products; plumbing supplies, lumber and others.

Competition Vanishes

In large sections of American industry today "competition has disappeared," the report continued. Recognizing that in many areas competitive conditions still exist, Jackson said this fact "only increases the advantages of great organizations able to control prices because they may obtain their raw material in the competitive market." The result, he said, is "disastrous price disparity."

Pending anti-trust law revision, a step which Attorney General Homer S. Cummings hopes will be taken during the present session of Congress, the Department of Justice will confine its anti-monopoly crusade to "three or four major offenders" whose activities show "the most serious injury to the public," it was disclosed in Jackson's report.

Citing the pending cases against the major oil companies, the Aluminum Co. of America and the automobile financing companies, as "the most flagrant," Jackson observed that "several other potential cases of equal importance" should be instituted, but that the department's existing trial staff is inadequate, money is lacking, and present laws are far from being "effective instruments" in curbing centralizing of economic control and rigid price structures.

Speeches Alibi To "Save Face," Critics Declare

Throughout the nation commentators described last week's "monopoly" radio speeches by Assistant Attorney General Jackson and Secretary of the Interior Ickes as "beating on a dishpan" designed to make the country forget the New Deal's part in the business recession. Typical comment follows:

Senator McNary (Republican Senate leader)—"If these speeches and this attempt to shift blame from itself (the New Deal) to business are kept up, fear will be increased, want of confidence will expand and the country will be plunged into the depths of a depression."

Arthur Krock (New York *Times*)—"Messrs. Jackson and Ickes . . . had a poor case and were attempting by an obvious political device to frighten politicians. Their Administration alibi is refutable by too many witnesses."

Dorothy Thompson—"I think this sudden championship of the 'little man,' this suddenly apparently fantastic reversal of the ideas of the NRA is a phoney. . . . I would like, for instance, to hear Mr. Jackson on the subject of the CIO, and the all-embracing, all-comprehending industrial union, with the closed shop. Is that a monopoly? Or isn't it?"

Walter Lippman — "Unless Mr. Jackson's speeches mark a revolution in the ideas of the New Dealers, these speeches are utterly unconvincing.

Industry Awaits Roosevelt's New "Trusts" Message

WASHINGTON, Jan. 4.—President Roosevelt's personal message to the Congress on Monday, milder than recent speeches by New Deal lieutenants Robert H. Jackson and Harold Ickes, deferred until a later date specific recommendations covering anti-trust revision which Mr. Roosevelt expects to outline in a special message.

He said that in its relationship with business the Government can be expected to "cooperate in every way" provided "the component parts of business abandon practices which do not belong to this day and age, and adopt price and production policies appropriate to the times."

Hopes for Business' Help

Expressing the hope that he will have "the help of business in the efforts of Government to help business," Mr. Roosevelt listed among other points "price rigging and collusive bidding" as practices which he said most people believe should be ended.

He also mentioned "high pressure salesmanship which creates cycles of over production within given industries and consequent recessions in production until such time as the surplus is consumed," the use of patent laws to enable larger corporations to maintain high prices and withhold from the public the advantages of the progress of science, and unfair competition which drives the smaller producer out of business locally, regionally or even on a national scale.

The President emphasized that business as a whole is not guilty of the enumerated abuses. "It is deception that will not long deceive to tell the country that an attack on these abuses is an attack on business," he said.

In the case of labor as in the case of capital, misrepresentation of the policy of the United States . . . will not long deceive. In both cases we seek cooperation. In every case power and responsibility must go hand in hand, the President said.

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New Type **ELWELL·PARKER** *Trucks*

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NEWS OF THE WEEK

McKown, Austin, Hilliard and Others Promoted by U. S. Steel

THOMAS J. HILLIARD

J. HALSEY McKOWN

DAVID F. AUSTIN

PITTSBURGH, Jan. 4.—J. Halsey McKown, of Pittsburgh, has been appointed assistant vice-president in charge of sales of United States Steel Corp. of Delaware. C. V. McKaig is vice-president in charge of sales.

At the same time Carnegie-Illinois Steel Corp., largest of U. S. Steel's subsidiaries, announced a reorganization of its principal sales offices with David F. Austin, Chicago district sales manager, going to Pittsburgh as vice-president in charge of sales, succeeding Mr. McKown.

Thomas J. Hilliard, now Pittsburgh district sales manager for Carnegie-Illinois, becomes general manager of sales in the new setup which was effective Jan. 1.

Other executive changes in the Carnegie-Illinois sales department on that same date are:

Frances C. Hardie as manager of sales of the Detroit district office, succeeding Philip M. Guba.

Mr. Guba as manager of sales in the Chicago district, succeeding Mr. Austin.

Thomas J. Bray, Jr., as Pittsburgh district sales manager, succeeding Mr. Hilliard.

F. Royal Gammon as Cleveland district sales manager, succeeding Mr. Hardie.

FRANCIS C. HARDIE

PHILIP M. GUBA

THOMAS J. BRAY, JR.

F. ROYAL GAMMON

Steel Exports in 1937 Treble Those Of Previous Year

WASHINGTON, Jan. 4.—November exports of iron and steel products, excluding scrap, were 301,280 tons, a decline of 10.6 per cent from October, according to the Metals and Minerals Division of the Bureau of Foreign and Domestic Commerce. The value of November exports, however, at $23,752,977, exceeded the October value by 1.9 per cent.

The 11-months' total was 3,165,343 tons compared with 1,086,062 tons in the corresponding period of 1936.

Tin plate exports of 52,795 tons in November were the largest ever shipped from this country within one month. The principal markets were Brazil (6227 tons), Japan (5246 tons), Argentina (4876 tons), the Soviet Union (4228 tons), Kwantung (4140 tons), and Hong Kong (3529 tons). In fact, tin plate exports for the 11 months were also at a record level—322,975 tons. In the entire history of the trade the highest annual total was 258,965 tons in 1929.

After recording declines for two consecutive months, iron and steel scrap exports in November moved up to 255,311 tons, an increase of 37.5 per cent in quantity and 20.1 per cent in value over October. Scrap exports in the 11 months of 1937 amounted to 3,776,123 tons valued at $73,875,076 compared with 1,827,088 tons valued at $23,064,161 in the corresponding period of 1936.

Westinghouse Chicopee Plant to Baltimore

THE radio division of Westinghouse Electric & Mfg. Co., now located at Chicopee Falls, Mass., is to be moved to Baltimore, with the transfer of equipment and employees expected to be completed within the next six months. The company has purchased a modern manufacturing plant in Baltimore and plans have been made for the erection of an adjacent office building. Other equipment now manufactured at Chicopee Falls, such as soft drink dispensing cabinets, will continue to be produced there.

Detroit Engineers Plan New Building

DETROIT, Jan. 4.—The architectural firm of Harley & Ellington has been engaged to design a proposed new memorial building for the Engineering Society of Detroit, according to the trustees of the Rackham Engineering Foundation. Possible sites are being studied. The building is to be a memorial to the late Horace H. Rackham. An endowment of $500,000 was created by the fund early in 1936 for the Engineering Society. Early in 1937 another half million dollar gift was made for the same purpose.

Steel Jobs Last Month Declined 6 Per Cent

STEEL industry employment in November was only 6 per cent under October although November steel production dropped 37 per cent below the preceding month, according to the American Iron and Steel Institute. Steel payrolls in November were 18½ per cent below October, a decline only half as great as the drop in steel output.

A total of 551,000 were employed in iron and steel plants during the month, as against 586,600 in October. The November, 1937, figure was higher than the total of 529,000 employed in November, 1936, although the volume of production was 50 per cent lower.

Payrolls of the industry for November, 1937, totaled $62,119,000, as against $76,191,000 in October, and $69,286,000 in November, 1936.

Hourly earnings averaged 82.1c. in November, 83.1c. in October, and 69.5c. one year before.

G-E Awarded Contract For Tanker's Turbines

GENERAL ELECTRIC CO. has been awarded the contract for the propelling machinery for a second turbo-electric, 18,500-ton welded tanker to be built for the Atlantic Refining Co. by the Sun Shipbuilding & Dry Dock Co. at its Chester, Pa., yards. Babcock & Wilcox Co. has been awarded the order for the vessel's new boilers. Scheduled for delivery in August, 1938, the new tanker and Atlantic's *J. W. Van Dyke*, launched in the Sun shipyards in November, will be the world's largest welded ships.

U. S. Steel Made Wage Reductions In Only 4 Years Out of 36

UNITED STATES STEEL CORP. has always been for high wages and has reduced pay of its employees in only four years of its 36-year existence, according to an analysis of "Who Pays Wages" in the January issue of *U. S. Steel News*.

Reminding its readers that hourly wages in the steel industry have increased from 16c. an hr. in 1902 to the present rate of 62½c. an hr. *U. S. Steel News* points out that from 1928 through 1936, the corporation paid in wages 85 per cent of its receipts after meeting other necessary expenditures.

"Wages cannot for long be paid at the expense of anyone and can be increased only by all producing more goods to share," the publication said. "Wages are paid by the public in the products which it uses and the public uses the products only when they are of a satisfactory quality and at a price which it wishes to pay. The public pays the wages."

Since the profitless years in United States Steel's record were not the high wage years, there "must be a catch in the notion that profits block wages," the publication said.

Accompanying the explanation of wages which followed an article printed in the *U. S. Steel News* of December on "How We Earn Our Living," was a table showing that from Jan. 1, 1928, to Dec. 31, 1936, United States Steel received $5,921,000,000 from the public in exchange for goods and services. Of this amount $2,142,000,000 went for goods and services purchased from others, $379,000,000 for taxes, and $457,000,000 for depreciation and depletion. Of the remaining $2,943,000,000, a total of $2,502,000,000 went for wages and salaries. During the eight-year period the corporation's dividends totaled $405,000,000.

Labor Board Denies Steel Union Request

WASHINGTON, Jan. 4.—The National Labor Relations Board has denied a request of the SWOC that employees of the Interlake Iron Corp., Chicago, vote for one of two labor organizations in an NLRB election called for before Jan. 8. Board Member Edwin S. Smith dissented.

Myron C. Taylor Defends Business From Its Critics

A SUGGESTION that Government should not discourage industry's efforts to bring about business recovery came this week from Myron C. Taylor in the United States Steel Corp. chairman's most significant statement on business in many months.

"Concerted action by the men and women of commerce and industry must and will set in motion the wheels which symbolize work, wages, comfort and happiness," said Mr. Taylor.

"The Government was never intended to take their place in the field of progressive individual effort or planning. To shift our burdens to its shoulders, as many would do, would mean the end of individual freedom. Neither should Government interfere, deter or discourage us in our efforts to conquer the ills from which we suffer."

Defending American businessmen from charges of non-cooperation and disloyalty, Mr. Taylor, in a year-end statement that drew close attention from all sectors of political and economic opinion, declared that:

"Men of commerce and industry uniformly and without any summons are seeking again to rebuild confidence, restore courage and relieve distress. They have an abiding affection for their country and may be depended upon to stanchly and without prejudice uphold our traditional conception of liberty.

Strive For Recovery

"For its preservation they will strive as before," he said, "to set up a renewed rhythm that will give opportunity to work and to live in peace and prosperity to those who inherited, as well as those of foreign birth who now enjoy the benefits of our free institutions.

"It is difficult for most of us to believe," Mr. Taylor said, "that the recession is more than temporary. . . . In any case we are comforted in the knowledge that the words 'retreat' or 'surrender' play no part in our mental attitude. They find no place in the American schoolboy's vocabulary and they are not heard in the councils of the nation's real leaders."

Mr. Taylor traced the background of depression and recovery in business during the last eight years.

"Although we may dispute various plans of approach to the problem of providing enlarged employment opportunities, the great basis of our American prosperity, we cling, to a man, to faith in America," Mr. Taylor concluded.

Affiliate Blames CIO For Blocking Peace With AFL

DISSATISFACTION with John L. Lewis' CIO over its failure to reach a settlement with the AFL in recent peace meetings was expressed privately this week by leaders of the International Ladies' Garment Workers' Union, the CIO affiliate which provided thousands of dollars for use in organizing steel workers.

At the same time in what some observers saw as a sign of growing discord within the CIO itself, the garment workers' union, of which David Dubinsky is president, said in its publication *Justice*:

"We refuse to believe that labor movement will accept the status of permanent civil war in its midst. In the fight (for industrial unionism in mass production industries) our union has done its share wholeheartedly and loyally. We had to face costly attacks upon us in many places because we are part of the CIO and we gladly paid the price. But our members had a right to hope and expect that when peace appeared realizable or possible it should and would be consummated."

A workable solution of the CIO's differences with the AFL was, according to the garment union publication, "tossed out the window."

Labor Will Resist Wage Cuts In 1938, William Green Says

WAGE reductions attempted by employers during 1938 will be resisted by organized labor "with all the power at its command," William Green, president of the American Federation of Labor, said this week in his annual New Year's statement.

"Reduced wages would only aggravate the situation by reducing and curtailing buying power," declared Mr. Green. Recently representatives of the other half of the organized labor movement, the CIO, said at a SWOC convention at Pittsburgh that labor's demands early in 1938 would be "tempered" by business conditions.

Industrialists examining Mr. Green's statement found threats that labor unions will seek still higher wages and shorter hours this next year. Said Mr. Green:

"Labor faces the New Year with alternating feelings of apprehension and hope. This state of mind is based upon the existence of an increasingly serious unemployment situation. The great army of unemployed which existed during the year 1937, numbering between eight and ten millions, has been increased by reason of the economic change which suddenly took place last September.

"Economic and industrial facts with which we are confronted at the close of the year 1937 justify the conclusion that unemployment will increase during the first six months of 1938. This means that labor will suffer because much of the distress of unemployment falls heavily upon it.

Will Protect Wages

"Labor will continue its organizing campaign with increasing aggressiveness and will mobilize its full economic strength in order to protect and preserve the wage standards which have been set up. We will also press for the acceptance of the shorter-work-day and shorter-work-week as a permanent remedy for unemployment."

Navy Opens Bids On Armor Plate

WASHINGTON, Jan. 4.—Low bidders on 13,696 tons of Class A armor for the battleships *North Carolina* and *Washington* were Bethlehem Steel Co., 8940 tons; Midvale Co., 3012 tons, and Carnegie-Illinois Steel Corp., 1744 tons. Bids were opened last Wednesday.

FABRICATED STEEL

. . . Lettings advance to 11,700 tons from 9710 tons last week.

o o o

. . . New projects lower at 8900 tons as against 9400 tons a week ago.

NORTH ATLANTIC STATES

Hillsgrove, R. I., 300 tons, city airport hangar, to Providence Steel & Iron Co., Providence, R. I.

Springfield, Mass., 200 tons, store, to an unnamed fabricator.

New Haven, Conn., 115 tons, A. C. Gilbert Co. building, to Berlin Construction Co., Berlin, Conn.

New York, 465 tons, public school No. 119 in Bronx, to Lehigh Structural Steel Co., Allentown, Pa.

Queens, N. Y., 215 tons, public school No. 134, to Bethlehem Fabricators, Inc., Bethlehem, Pa.

Hartsdale, N. Y., 140 tons, grade school, to Belmont Iron Works, Philadelphia.

THE SOUTH

Louisville, Ky., 290 tons, Spring Street bridge, to Virginia Bridge Co., Roanoke, Va.

San Antonio, Tex., 315 tons, repair and plate shops, to Alamo Iron Works, San Antonio.

Port Arthur, Tex., 395 tons, Woodrow Wilson High School, to Orange Car & Steel Co., Orange, Tex.

CENTRAL STATES

Lansing, Mich., 1525 tons, addition to power plant, to R. C. Mahon Co., Detroit.

Dayton, Ohio, 260 tons, factory and office building, Cimatool & Sheffield Gage Co., to Burger Iron Works, Akron, Ohio.

Niles Center, Ill., 280 tons, high school, to Wendnagel & Co., Chicago.

La Crosse, Wis., 3300 tons, State bridge over Mississippi River, to Bethlehem Steel Co., Bethlehem, Pa.

Milwaukee, 2210 tons, Pulaski High School, to Milwaukee Bridge Co., Milwaukee.

WESTERN STATES

Los Angeles, 225 tons, Centinela Avenue bridge for United States Engineer, to Bethlehem Steel Co., Los Angeles.

Los Angeles, 235 tons, Pacific-Electric Co. main-line bridge over Compton Creek for United States Engineer, to Lakeside Bridge & Steel Co., Milwaukee; previously reported awarded to Wisconsin Bridge & Iron Co., Milwaukee.

Los Angeles, 600 tons, second crossing, Los Angeles River, Southern Pacific Co., to American Bridge Co., Pittsburgh.

NEW STRUCTURAL STEEL PROJECTS

NORTH ATLANTIC STATES

New York, 400 tons, alterations to building, Hospital of Joint Diseases.

New York, 1000 tons, bulb angles for United States Treasury Department.

New York, 350 tons, building, Real Estate Industrials, Inc.

New York, 300 tons, Department of Sanitation garage.

New York, 200 tons, laundry building, East 49th Street.

New York, 315 tons, roadway and underpass, Exterior Street and East 138th Street, in Bronx; Knight & Timoney, Bronx, low bidders.

East Northport, N. Y., 100 tons, grade school.

Huntington, N. Y., 300 tons, junior high school.

Cheektowaga, N. Y., 175 tons, State highway bridge across New York Central tracks.

Tioga County, N. Y., 110 tons, State highway bridge; bids taken Jan. 4.

Dalton, N. Y., 200 tons, centralized school; Porter Building Co., Buffalo, low bidder on general contract.

Greigsville, N. Y., 200 tons, centralized school.

CENTRAL STATES

Cleveland, 300 tons, Cuyahoga Heights high school; bids Jan. 17 on revised plans.

Toledo, Ohio, 350 tons, repairs to Fassett Street bridge.

Chicago, 200 tons, addition to union stockyards building, for Wilson & Co.

Hennepin, Ill., 2000 tons, State bridge.

Dubuque, Ill., 110 tons, railroad bridge.

Cook County, Ill., 600 tons, State bridge.

Forestburg, S. D., 110 tons, I-beam State viaduct.

WESTERN STATES

Los Angeles, 105 tons, Lower Canada Boulevard Bridge for United States Engineer, Ingalls Iron Works Co., Birmingham, low bidder.

Sacramento, Cal., 180 tons, grandstand and building additions at Agricultural Park; bids Jan. 18.

SHEET PILING

NEW PROJECTS

Cheektowaga, N. Y., 150 tons, State highway bridge across New York Central tracks.

CAST IRON PIPE

Centerville-Osterville (Mass.) Fire District has plans for 19 miles of a 6 to 12-in. water pipe, 160 fire hydrants, and pumping station and equipment to cost approximately $432,000. Whitman & Howard, 89 Broad Street, Boston, are engineers.

Alliance, Ohio, W. E. Harrington, service director, will receive bids Jan. 12 on 6200 ft. of 6-in. water pipe.

Cincinnati has taken bids on 602 tons of 4 to 12-in. centrifugally cast iron pipe.

Anaheim, Cal., has awarded 267 tons of 4 to 10-in. pipe and fittings to National Cast Iron Pipe Co., Los Angeles.

Spokane, Wash., has awarded 135 tons of 6 and 12-in. pipe to Pacific States Cast Iron Pipe Co., Provo, Utah.

Sanger, Cal., has awarded 250 tons of 8 and 10-in. pipe, fittings, and hydrants to Pacific States Cast Iron Pipe Co., Provo, Utah.

La Mesa, Lemon Grove, & Spring Valley Irrigation District, La Mesa, Cal., will call for bids Jan. 18 on Unit 2 of its distribution pipe line replacement project which will require 75,069 ft. of pipe and 82,325 lb. of fittings.

PIPE LINES

Pleasant Home Water District, Portland, Ore., asks bids Jan. 14 for water system improvements. About 45,500 ft. of 2, 3, 4, and 6-in. pipe, and pump, pumphouse, meters, concrete reservoirs, and appurtenances will be required.

O. C. Field Gasoline Corp., Los Angeles, is contemplating construction of five miles of 8-in. pipe from Casmalia to Casmalia Beach, Cal., or 40 miles from Casmalia to Gaviota.

Union Oil Co. of California may soon build 12-in. pipe line from Santa Maria to Port San Luis, Cal.

Richfield Oil Co. of California, in conjunction with other interests, is considering construction of a pipe line from Gaviota Ridge to Casmalia, Cal.

RAILROAD BUYING

Chesapeake & Ohio is asking for bids on 25 70-ton covered hopper cars.

Norfolk Southern is inquiring for five locomotives.

American Car & Foundry Motors Co. has received the following orders for motor coaches: 10 for Staten Island Coach Corp., Staten Island, N. Y.; four for Triple Cities Traction Corp., Binghamton, N. Y.; and one for F. D. & D. S. Bus Co., Bayonne, N. J.

RAILS AND TRACK SUPPLIES

Chesapeake & Ohio has allocated 27,500 tons of rails as follows: 14,700 tons to Carnegie-Illinois Steel Corp.; 9600 tons to Inland Steel Co. and 3200 tons to Bethlehem Steel Co. Track fastenings in connection with this purchase will be awarded later.

IRON and STEEL SCRAP

. . . Market stronger at Philadelphia and Chicago; railroad grades show advance at Pittsburgh.

o o o

. . . Otherwise, prices are nominally unchanged at most centers.

o o o

. . . Composite rises 25c. to $14.00.

JAN. 4.—While dealer's heavy melting steel is still quotable at $14 to $14.50 at Pittsburgh, higher consumer and broker buying prices at Philadelphia have advanced quotations on No. 1 steel to $14.50 to $15, restoring the disparity that, except for last week, has prevailed since Nov. 23. At Chicago, principal grades are up 25c., making No. 1 steel around $13, although brokers are no longer bidding up to $14 to cover old orders, as was the case two weeks ago. THE IRON AGE'S composite now stands at $14, up 25c. from last week and $1.08 above the low point of $12.92, last noted on Nov. 30. Otherwise, the year is off to a quiet start from the standpoint of activity in most districts.

The market at Pittsburgh is marking time until railroad lists are closed this week. In the meantime, railroad heavy melting steel has risen 25c., the current quotation being $15 to $15.50. The Baltimore & Ohio's list is reported to have brought $15.75 at seaboard for export. On the other hand, only small amounts of scrap have been put up for sale by the New York Central and the Erie owing to greatly reduced shop operations. For a similar reason, the accumulations of scrap at Detroit will be very light this month. A sale of bundles there brought $11.25, up 25c., whereas the January list of Budd bundles at Philadelphia brought about $15, up 50c.

Exporters seem willing to pay $15 for carlots of No. 1 at Philadelphia, although by year end all of the old high-priced order material had been shipped. Material now being shipped is against the last European Scrap Cartel order of 500,000 tons, made in mid-November, which brought $16.50 for No. 1 at boats. Export buying prices are quoted unchanged at the three principal ports, however.

One of the largest scrapping operations ever undertaken will start in Ohio shortly with the tearing up of 145 miles of abandoned track and electrical overhead of the Springfield-Toledo division of the Cincinnati & Lake Erie Railroad. Summer & Co. of Columbus paid $261,000 for the track and overhead. An estimated 17,000 tons of track is involved.

Pig Iron Output Down In December

PRODUCTION of coke pig iron in December totaled 1,478,843 gross tons, compared with 2,006,724 tons in November. The daily rate in December, at 47,705 tons, was 28.7 per cent below the 66,891 tons in November and was the lowest since January, 1935, when it stood at 47,656 tons.

Production for the year totaled 36,599,836 tons, a gain of 19.5 per cent over the 30,618,797 tons in 1936.

There was a lost of 20 furnaces, 93 being in blast on Jan. 1, against 113 on Dec. 1.

Among the furnaces blown out or banked were the following: Troy furnace, of the Troy Furnace Corp.; one Clairton, one Ohio, two South Chicago (old), one Gary, Carnegie-Illinois Steel Corp.; two Tennessee Coal, Iron & Railroad Co.; one Cambria, one Sparrows Point, Bethlehem Steel Co.; one Perry, one Toledo, Pickands, Mather & Co.; one Oriskany, E. J. Lavino & Co.; one Riverside, Wheeling Steel Corp.; one Weirton and one Detroit, National Steel Corp.; one Pioneer, one River, one Hazelton, and one Trumbull Cliffs, Republic Steel Corp.

Complete tabulations will be published next week.

Taylor Has Talk With Roosevelt

WASHINGTON, Jan. 4.—President Roosevelt and Myron C. Taylor, chairman, United States Steel Corp., ate their final 1937 luncheon together in the President's executive office last Friday.

But Mr. Taylor, his year-end call at the White House arousing particular interest because of attacks by high ranking New Deal officials on big business and so-called high prices, would make no comment either before or after calling on the President.

It was reported, however, that the conference centered around steel prices, which can hardly be reduced unless labor costs are also decreased.

REINFORCING STEEL

. . . Awards of 1660 tons—2180 tons in new projects.

AWARDS

Deer Isle, Me., 200 tons, State bridge, to Concrete Steel Co., New York.

Newark, N. J., 1000 tons, apartment building, MacEvoy Construction Co., to Joseph T. Ryerson & Son, Inc., New York.

New York, 160 tons, Canal Street post office, to Capitol Steel Corp., New York.

Syracuse, N. Y., 100 tons, Edward Smith Junior High School, to Concrete Steel Co., New York.

Abingdon, Va., 200 tons, United States Department of Research building, to American Steel Engineering, Philadelphia.

NEW REINFORCING BAR PROJECTS

New Britain, Conn., 100 tons, Cremo Brewing Co. building.

New York, 140 tons, roadway and underpass, Exterior Street and East 138th Street, in Bronx; Knight & Timoney, Bronx, low bidders.

Cheektowaga, N. Y., 100 tons, State highway bridge across New York Central tracks.

Charleston, W. Va., 275 tons, Elk River bridge.

Cincinnati, 100 tons, building for Procter & Gamble; Ferro Concrete Construction Co., Cincinnati, general contractor.

Chicago, 140 tons, sanitary district, contract 11-A.

West Allis, Wis., 100 tons, John Dewey High School.

Stockton, Cal., 141 tons, State hospital building; bids opened.

Pasadena, Cal., 104 tons, post office extension; bids opened.

El Monte, Cal., 270 tons, school buildings; W. W. Petley, Los Angeles, general contractor.

Vernon, Cal., 850 tons, packing plant for Swift & Co.; bids taken.

Iron and Steel Scrap Prices

PITTSBURGH

Per gross ton to delivered to consumer:

No. 1 hvy. mltng. steel.	$14.00 to $14.50
Railroad hvy. mltng.	15.00 to 15.50
No. 2 hvy. mltng. steel.	12.50 to 13.00
Scrap rails	15.50 to 16.00
Rails 3 ft. and under	18.00 to 18.50
Comp. sheet steel	14.00 to 14.50
Hand bundled sheets	13.00 to 13.50
Hvy. steel axle turn.	12.50 to 13.00
Machine shop turn.	7.50 to 8.00
Short shov. turn.	7.50 to 8.00
Mixed bor. & turn.	6.50 to 7.00
Cast iron borings	6.50 to 7.00
Cast iron carwheels	15.00 to 15.50
Hvy. breakable cast	12.50 to 13.00
No. 1 cupola cast	16.00 to 16.50
RR. knuckles & cplrs.	18.00 to 18.50
Rail coil & leaf springs	18.00 to 18.50
Rolled steel wheels	18.00 to 18.50
Low phos. billet crops	18.00 to 18.50
Low phos. sh. bar	17.50 to 18.00
Low phos. punchings	16.50 to 17.00
Low phos. plate, hvy.	17.00 to 17.50
Low phos. plate clips	14.50 to 15.00
Steel car axles	17.50 to 18.00

PHILADELPHIA

Per gross ton to delivered to consumer:

No. 1 hvy. mltng. steel.	$14.50 to $15.00
No. 2 hvy. mltng. steel.	13.50 to 14.00
Hydraulic bund., new	14.50 to 15.00
Hydraulic bund., old	10.50 to 11.00
Steel rails for rolling	17.00 to 17.50
Cast iron carwheels	16.00 to 16.50
Hvy. breakable cast	14.00 to 14.50
No. 1 cast	16.50 to 17.00
Stove plate (steel wks.)	13.00 to 13.50
Railroad malleable	16.00 to 16.50
Machine shop turn.	9.00 to 9.50
No. 1 b'ast furnace	8.25 to 8.75
Cast borings	8.50 to 9.00
Heavy axle turnings	11.50 to 12.00
No. 1 low phos. hvy.	18.00 to 18.50
Couplers & knuckles	18.00 to 18.50
Rolled steel wheels	18.00 to 18.50
Steel axles	20.00 to 20.50
Shafting	19.50 to 20.00
No. 1 RR. wrought	16.00 to 16.50
Spec. iron & steel pipe	13.00 to 13.50
No. 1 forge fire	12.00 to 12.50
Cast borings (chem.)	13.50 to 14.00

CHICAGO

Delivered to Chicago district consumers:

	Per Gross Ton
Hvy. mltng. steel	$12.75 to $13.25
Auto. hvy. mltng. steel alloy free	11.25 to 11.75
No. 2 auto. steel	10.75 to 11.25
Shoveling steel	12.75 to 13.25
Hydraul. comp. sheets	11.75 to 12.25
Drop forge flashings	10.25 to 10.75
No. 1 busheling	11.75 to 12.25
No. 2 busheling, old	5.75 to 6.25
Rolled carwheels	16.00 to 16.50
Railroad tires, cut	16.25 to 17.25
Railroad leaf springs	17.00 to 17.50
Steel coup. & knuckles	16.00 to 16.50
Axle turnings	12.00 to 12.50
Coil springs	17.50 to 18.00
Axle turn. (elec.)	12.50 to 13.00
Low phos. punchings	16.00 to 16.50
Low phos. plates, 12 in. and under	15.50 to 16.00
Cast iron borings	6.50 to 7.00
Short shov. turnings	8.50 to 9.00
Machine shop turn.	7.00 to 7.50
Rerolling rails	15.25 to 15.75
Steel rails under 3 ft.	15.50 to 16.00
Steel rails under 2 ft.	16.00 to 16.50
Angle bars, steel	15.25 to 15.75
Cast iron carwheels	15.25 to 15.75
Railroad malleable	14.75 to 15.25
Agric. malleable	12.25 to 12.75
	Per Net Ton
Iron car axles	$19.00 to $19.50
Steel car axles	17.00 to 17.50
No. 1 RR. wrought	10.50 to 11.00
No. 2 RR. wrought	11.25 to 11.75
Locomotive tires	15.75 to 16.25
Pipes and flues	9.25 to 9.75
No. 1 machinery cast	12.55 to 12.75
Clean auto. cast	12.00 to 12.50
No. 1 railroad cast	11.25 to 11.75
No. 1 agric. cast	11.25 to 11.75
Stove plate	9.00 to 9.50
Grate bars	9.00 to 9.50
Brake shoes	8.50 to 9.00

YOUNGSTOWN

Per gross ton to delivered to consumer:

No. 1 hvy. mltng. steel.	$13.00 to $13.50
Hydraulic bundles	12.50 to 13.00
Machine shop turn.	10.00 to 10.50

CLEVELAND

Per gross ton to delivered to consumer:

No. 1 hvy. mltng. steel.	$12.50 to $13.00
No. 2 hvy. mltng. steel.	11.50 to 12.00
Comp. sheet steel	12.00 to 12.50
Light bund. stampings.	9.00 to 9.50
Drop forge flashings	11.50 to 12.00
Machine shop turn.	7.50 to 8.00
Short shov. turn.	9.00 to 9.50
No. 1 busheling	11.50 to 12.00
Steel axle turnings	10.00 to 10.50
Low phos. billet and bloom crops	18.50 to 19.50
Cast iron borings	8.50 to 9.00
Mixed bor. & turn.	8.50 to 9.00
No. 2 busheling	8.50 to 9.00
No. 1 cast	16.50 to 17.00
Railroad grate bars	8.00 to 8.50
Stove plate	8.00 to 8.50
Rails under 3 ft.	18.00 to 18.50
Rails for rolling	16.00 to 16.50
Railroad malleable	16.00 to 16.50
Cast iron carwheels	15.00 to 15.50

BUFFALO

Per gross ton, f.o.b. consumers' plants:

No. 1 hvy. mltng. steel.	$13.00 to $13.50
No. 2 hvy. mltng. steel.	11.00 to 11.50
Scrap rails	13.00 to 13.50
New hvy. b'ndled sheets	11.00 to 11.50
Old hydraul. bundles	10.00 to 10.50
Drop forge flashings	11.00 to 11.50
No. 1 busheling	11.00 to 11.50
Hvy. axle turnings	11.50 to 12.00
Machine shop turn.	6.75 to 7.25
Knuckles & couplers	16.50 to 17.00
Coil & leaf springs	16.50 to 17.00
Rolled steel wheels	16.50 to 17.00
Low phos. billet crops.	17.50 to 18.00
Shov. turnings	8.50 to 9.00
Mixed bor. & turn.	7.50 to 8.00
Cast iron borings	7.50 to 8.00
Steel car axles	16.50 to 17.00
No. 1 machinery cast.	15.50 to 16.00
No. 1 cupola cast	14.00 to 14.50
Stove plate	12.00 to 12.50
Steel rails under 3 ft.	17.00 to 17.50
Cast iron carwheels	15.00 to 15.50
Railroad malleable	15.00 to 15.50
Chemical borings	10.50 to 11.00

ST. LOUIS

Dealers' buying prices per gross ton delivered to consumer:

Selected hvy. melting.	$13.00 to $13.50
No. 1 hvy. melting	13.00 to 13.50
No. 2 hvy. melting	12.00 to 12.50
No. 1 locomotive tires.	16.00 to 16.50
Misc. stand.-sec. rails.	13.50 to 14.00
Railroad springs	15.00 to 15.50
Bundled sheets	8.00 to 8.50
No. 1 busheling	7.00 to 7.50
Cast bor. & turn.	6.00 to 6.50
Rails for rolling	14.50 to 15.00
Machine shop turn.	6.00 to 6.50
Heavy turnings	8.50 to 9.00
Steel car axles	19.50 to 20.00
Iron car axles	21.50 to 22.00
No. 1 RR. wrought	8.00 to 8.50
No. 2 RR. wrought	13.00 to 13.50
Steel rails under 3 ft.	16.00 to 16.50
Steel angle bars	14.50 to 15.00
Cast iron carwheels	13.50 to 14.00
No. 1 machinery cast.	12.75 to 13.25
Railroad malleable	13.50 to 14.00
No. 1 railroad cast	13.25 to 13.75
Stove plate	9.00 to 9.50
Agricul. malleable	10.00 to 10.50
Grate bars	9.50 to 10.00
Brake shoes	9.50 to 10.00

CINCINNATI

Dealers' buying prices per gross ton:

No. 1 hvy. mltng. steel.	$9.50 to $10.00
No. 2 hvy. mltng. steel.	7.50 to 8.00
Scrap rails for mltng.	14.50 to 15.00
Loose sheet clippings.	6.00 to 6.50
Hydrau. b'ndled sheets	9.50 to 10.00
Cast iron borings	3.50 to 4.00
Machine shop turn.	4.00 to 4.50
No. 1 busheling	8.00 to 8.50
No. 2 busheling	3.00 to 3.50
Rails for rolling	16.50 to 17.00
No. 1 locomotive tires.	13.00 to 13.50
Short rails	17.00 to 17.50
Cast iron carwheels	11.50 to 12.00
No. 1 machinery cast.	10.50 to 11.00
No. 1 railroad cast	9.00 to 9.50
Burnt cast	5.50 to 6.00
Stove plate	5.50 to 6.00
Agricul. malleable	10.50 to 11.00
Railroad malleable	12.50 to 13.00
Mixed hvy. cast	7.50 to 8.00

BIRMINGHAM

Per gross ton delivered to consumer:

Hvy. melting steel	$16.00 to $16.50
Scrap steel rails	17.00
Short shov. turnings	8.50
Stove plate	10.50
Steel axles	18.00 to 19.00
Iron axles	15.50 to 18.00
No. 1 RR. wrought	13.00 to 15.00
Rails for rolling	18.00 to 20.00
No. 1 cast	16.00 to 18.00
Tramcar wheels	16.00 to 18.00

DETROIT

Dealers' buying prices per gross ton:

No. 1 hvy. mltng. steel.	$9.50 to $10.00
No. 2 hvy. mltng. steel.	8.00 to 8.50
Borings and turnings	6.25 to 6.75
Long turnings	5.25 to 5.75
Short shov. turnings	6.75 to 7.25
No. 1 machinery cast.	11.75 to 12.25
Automotive cast	12.75 to 13.25
Hvy. breakable cast	10.25 to 10.75
Hydraul. comp. sheets.	10.50 to 11.00
Stove plate	7.50 to 8.00
New factory bushel	9.50 to 10.00
Old No. 2 busheling	5.00 to 5.50
No. 2 busheling (black fender stock)	Nominal
Sheet clippings	7.00 to 7.50
Flashings	8.50 to 9.00
Low phos. plate scrap.	10.50 to 11.00

NEW YORK

Dealers' buying prices per gross ton on cars:

No. 1 hvy. mltng. steel.	$10.50 to $11.00
No. 2 hvy. mltng steel.	9.00 to 9.50
Hvy. breakable cast	9.50 to 10.00
No. 1 machinery cast.	11.50 to 12.00
No. 2 cast	9.50 to 10.00
Stove plate	8.50 to 9.00
Steel car axles	19.00 to 19.50
Shafting	16.00 to 16.50
No. 1 RR. wrought	11.00 to 11.50
No. 1 wrought long	10.00 to 10.50
Spec. iron & steel pipe	9.00 to 9.50
Rails for rolling	16.00 to 16.50
Clean steel turnings	5.00 to 5.50
Cast borings	5.00 to 5.50
No. 1 blast furnace	5.00 to 5.50
Cast borings (chem.)	10.00 to 10.50
Unprepar. yard scrap	7.50 to 8.00
Per gross ton, delivered local foundries:	
No. 1 machn. cast	$15.50 to $16.00
No. 2 cast	11.00 to 11.50

BOSTON

Dealers' buying prices per gross ton:

No. 1 hvy. mltng. steel.	$13.30 to $13.80
Scrap rails	13.30 to 13.80
No. 2 steel	12.30 to 12.80
Breakable cast.	8.50
Machine shop turn.	3.15
Mixed bor. & turn.	2.50
Bun. skeleton long.	6.60
Shafting	17.50 to 18.00
Cast bor. chemical	8.00 to 8.50
Per gross ton delivered consumers' yards:	
Textile cast	$15.50 to $16.00
No. 1 machine cast	15.50 to 16.00

PACIFIC COAST

Per gross ton delivered to consumer:

No. 1 hvy. mltng. steel.	$10.50 to $11.00
No. 2 hvy. mltng. steel.	9.50 to 10.00

CANADA

Dealers' buying prices at their yards, per gross ton:

	Toronto	Montreal
No. 1 hvy. mltng. steel.	$10.50	$9.50
No. 2 hvy. mltng. steel.	9.50	8.50
Mixed dealers steel	8.50	7.50
Scrap pipe	8.50	7.50
Steel turnings	7.50	7.00
Cast borings	8.50	7.50
Machinery cast	15.00	14.00
Dealers cast	13.00	12.00
Stove plate	11.00	10.50

EXPORT

Dealers' buying prices per gross ton:

New York, truck lots, delivered, barges	
No. 1 hvy. mltng. steel.	$13.50
No. 2 hvy. mltng. steel.	12.00
No. 2 cast	11.00
Stove plate	8.50 to 9.00
Boston on cars at Army Base or Mystic Wharf	
No. 1 hvy. mltng. steel.	$14.00 to $14.50
No. 2 hvy. mltng. steel.	13.00 to 13.75
Rails (scrap)	14.00 to 14.50
Philadelphia, delivered alongside boats. Port Richmond	
No. 1 hvy. mltng. steel.	$14.50 to $15.00
No. 2 hvy. mltng. steel.	13.50 to 14.00

METALS

Influence of "trace" elements in characteristics and performance of metals is becoming appreciated with improvement in means of determination.

By SAM TOUR

Vice-President, Lucius Pitkin, Inc.

FOR years the non-ferrous metallurgist has appreciated the great importance of trace elements, although the ferrous metallurgist has often not given the subject enough attention. In this article, the author defines a trace element, sketches the influence of trace elements in non-ferrous metals, and presents a review of the more useful methods of determining traces qualitatively and quantitatively.

WHAT is a "trace" and what is a "trace element?" Webster defines "trace" as applied to chemistry as follows: "A very small quantity of a constituent, especially when not quantitatively determined owing to minuteness." The general definition is given for the word "trace" as "a very small amount; a barely discernible quantity." The Century Dictionary defines "trace" as—"an insignificant proportion." On the basis of the Webster definition, the word "trace" becomes associated with the method used for a quantitative determination. If the method of determination is crude, then a considerably larger quantity may be classed as a trace than if the method is highly refined. In some methods of chemical analysis, a quantity of the order of 0.05 per cent is the minimum that can be weighed or measured with any degree of precision and with these methods of analysis any amounts under 0.05 per cent become "traces." As better methods are developed or used and as the minimum quantity which can be determined with some precision is reduced to a matter of 0.01 per cent, then anything under 0.01 per cent falls under the class of "a trace." Similarly, as new and better methods are developed which will determine amounts in the order of 0.001 per cent with some degree of precision, then amounts under that quantity may be termed as "traces."

It is evident then that this definition of the word "trace" has no relationship to the effects which that "trace" might have. Any definition of the word "trace" as being "an insignificant proportion" is obviously erroneous if the amount present even in a very small quantity does have a significant effect.

Often the various trace elements present in non-ferrous metals are referred to under the general term of "impurities." The word "impurity," however, connotes something objectionable in more ways than simply lowering the total over-all percentage of the parent metal present. In other words, the term "impurity" would indicate that even though a "trace element" present imparts some useful properties to the parent metal, it is still objectionable. Obviously any such term is improperly applied to desirable "trace elements."

For the purposes of the present discussion, the phrase "trace elements" will be used as indicating elements present in amounts less than 0.05 per cent. Thus the term "trace elements" is not used as in any way indicative of the method of analysis used, nor in any way indicative of whether the

trace element present is advantageously present or the reverse. An attempt will be made to show how trace elements present, and very often given no thought or consideration, may be of vast importance and may be either highly detrimental or highly beneficial in their effect upon the properties of the parent metal in which they are present.

While ferrous metallurgists have been engaged for a number of years in speculations as to the causes of grain size variation and various other physical variations in ferrous metals as possible due to non-metallic inclusions (the slag-cloud hypothesis), the non-ferrous metallurgists have been busily studying the presence or absence of "trace elements" and the effect of these "trace elements." In this study, the non-ferrous metallurgists have been learning many valuable and interesting things. It has become apparent that trace elements are often of vital importance. In certain cases specific trace elements must be retained in the parent metal, while other specific trace elements must be removed or excluded. A few examples of the importance of trace elements in non-ferrous metals will demonstrate this point.

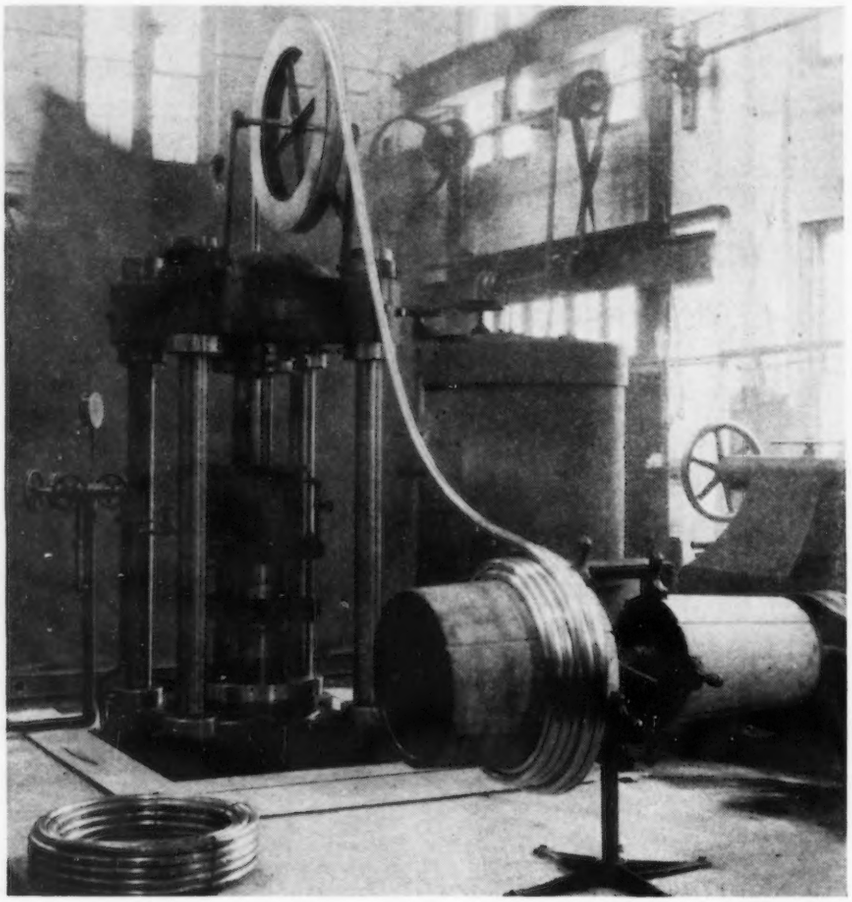

FIG. 1—Lead pipe press extruding service water pipe of lead containing carefully controlled trace elements. Photo courtesy of John Robertson Co., Brooklyn, N. Y.

Lead

Lead is one of the important non-ferrous metals which has been produced for years in a grade containing over 99.9 per cent of lead. In other words, it is a common non-ferrous metal of commerce of an apparent high degree of purity. In spite of this high degree of purity, however, it contains a number of trace elements present in amounts less than 0.01 per cent. A regularly produced and used lead on the market is over 99.98 per cent pure lead. The trace elements present in this lead are said to consist largely of silver, copper, arsenic, antimony, tin, zinc, iron and bismuth. Are these trace elements present in this high purity lead harmful? Decidedly not. In fact, some lead of 99.999 per cent purity has been produced which shows such low physical properties that it hardly has any commercial application. Dr. A. J. Phillips, of the American Smelting & Refining Co., reports that tests on lead of 99.98 per cent purity show a tensile strength of 1700 to 1800 lb. per sq. in. and a creep strength of over 200 lb. per sq. in.; whereas a lead of 99.999 per cent purity showed an ultimate tensile strength of only 1450 lb. per sq. in. and a creep strength much less than 150 lb. per sq. in. In other words, the removing of a portion of these trace elements present in total in an amount less than 0.02 per cent has caused a loss in physical properties of such magnitude as to make very questionable the value of the extra purity obtained.

The work by Doctor Phillips, however, has shown also that certain trace elements present in lead of otherwise satisfactory purity are of vast importance in changing other than the normal physical properties of the lead. In connection with studies of oxidation rates of molten lead, he reports that arsenic present in amounts between 0.002 and 0.003 per cent increases the oxidation rate of molten lead in air some three to five times, and that antimony present in amounts between 0.02 and 0.03 per cent increases this oxidation rate in air some five to ten times. Effects of this nature may be advantageous or disadvantageous according to the particular application of the lead in question. If the lead is being used in a molten condition where oxidation is objectionable, then these trace elements present will be objectionable, but if the lead is being used for the production of lead oxide where oxidation is desirable, then the presence of these trace elements is decidedly beneficial. Careful control of "trace elements" in lead is everyday practice in industrial applications such as that shown in Fig. 1.

Zinc

Zinc is a non-ferrous metal in which "trace elements" are again of vital importance. In some cases, their effects are objectionable while in other cases their effects are very beneficial indeed. Possibly one of the best illustrations of the powerful effect of trace elements on zinc and zinc alloys is in the zinc-base die casting field. The development of 99.99+ per cent pure zinc some eight or ten years ago has made it possible for the zinc-base die casting industry to put into practical use the knowledge which had been gained regarding the effects of trace elements on zinc-base alloys containing around 4 per cent of aluminum. In these alloys both harmful and beneficial trace elements have

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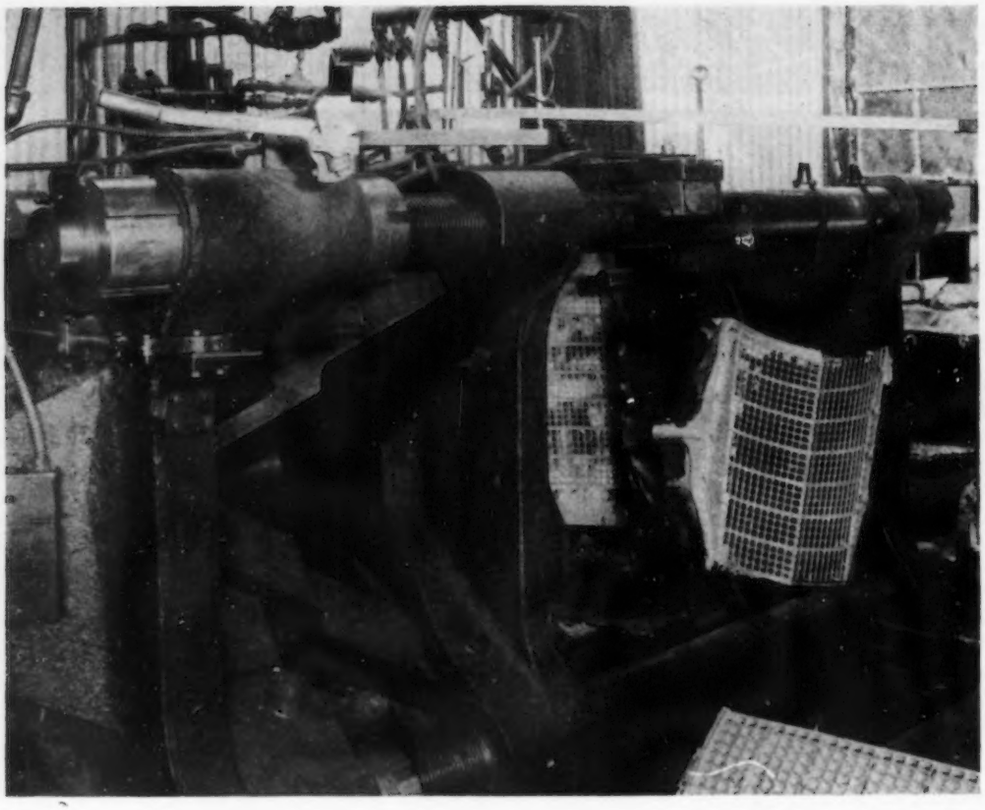

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FIG. 2—A modern die casting machine producing cast automobile radiator grilles of zinc-base alloy carefully controlled as to trace elements. Photo courtesy of Precision Castings Co., Syracuse, N. Y.

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been found. A zinc-base alloy containing essentially only 4 per cent aluminum and the balance high purity zinc has very desirable physical properties as originally cast. If, however, this alloy has been contaminated with the trace elements lead and tin, or either of them to amounts over 0.01 per cent of lead or 0.005 per cent of tin, the castings will not retain their desirable physical properties if exposed to warm, humid atmospheres. If these trace elements are kept below 0.007 per cent of lead and 0.002 per cent of tin, then the physical properties will be much more stable. These trace elements lead and tin are thus harmful to the zinc-aluminum alloys. Other trace elements, however, have been found which tend to counteract these harmful effects of lead and tin and to stabilize the zinc-aluminum alloys. In this way, 0.02 to 0.04 per cent of magnesium has been

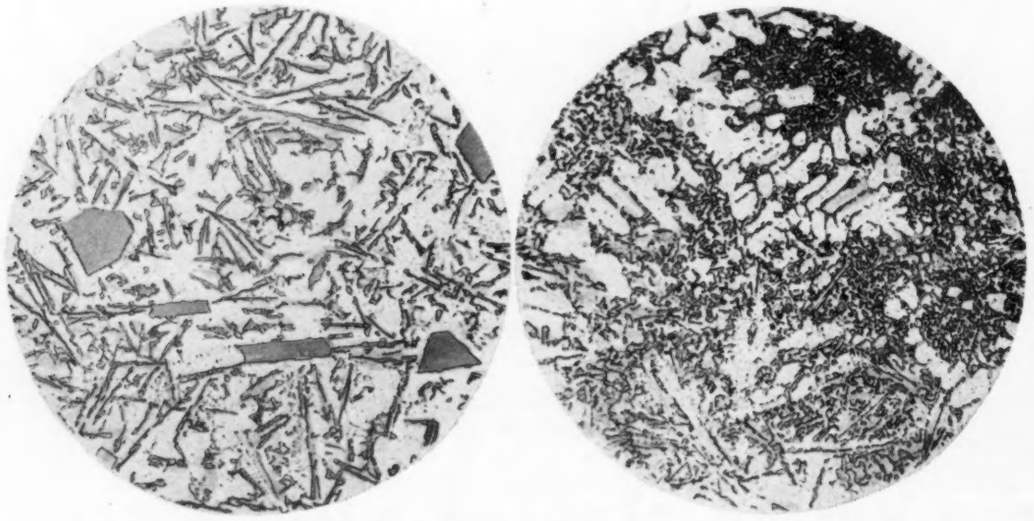

FIG. 3—(Left) A complex aluminum-silicon alloy, sodium less than 0.001 per cent; at 250 diameters. (Right) The same alloy but with 0.005 per cent sodium; at 250 diameters. Note the difference due to the variation in the trace of sodium.

PRINCIPAL FERRO-ALLOYS AND METALS

CHROMIUM
Low-Carbon Ferrochrome (in grades, maximum 0.06% to maximum 2.00% carbon)
High-Carbon Ferrochrome (maximum 6.00% carbon)
High-Nitrogen Ferrochrome
Chromium Metal
Chromium-Copper
Miscellaneous Chromium Alloys

MANGANESE
Standard Ferromanganese 78 to 82%
Low-Carbon Ferromanganese
Medium-Carbon Ferromanganese
Spiegeleisen
Manganese Metal
Manganese-Copper
Miscellaneous Manganese Alloys

SILICON
Ferrosilicon 15%
Ferrosilicon 50%
Ferrosilicon 75%
Ferrosilicon 80 to 90%
Ferrosilicon 90 to 95%
Refined Silicon (minimum 97% silicon)
Miscellaneous Silicon Alloys

SILICO-MANGANESE
All grades including Silico-Spiegel

CALCIUM
Calcium-Silicon
Calcium-Aluminum Silicon
Calcium-Manganese-Silicon

TUNGSTEN

ZIRCONIUM
12 to 15% Zirconium
35 to 40% Zirconium
Aluminum-Zirconium

VANADIUM
All grades

BRIQUETS
(Patented)
Chrome Briquets
Manganese Briquets
Silicon Briquets

COLUMBIUM

PRODUCTS OF A UNIT OF UCC UNION CARBIDE AND CARBON CORPORATION

The word "Electromet" used herein is a registered trade-mark.

Co-ordination

The delicate balance and intricate movement of the figure skater require perfect co-ordination of nerve, muscle, and mind. Without this co-ordination, even the finest alloy steel in the blades of his skates cannot make the figure a success . . . And long before the steel has reached its final form as a skate blade, perfect co-ordination of many complex metallurgical factors is required to make the steel a success. The correct amount of the right ferro-alloys must be added to the steel in the furnace at the proper time under suitable operating conditions.

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found to be decidedly beneficial in the zinc-aluminum alloys and to tend to counteract the harmful effect of the traces of lead and tin which are so difficult to keep out or to remove. Other beneficial elements have been found but are not apparently as powerful as magnesium in producing stability. Like lead, trace elements in zinc are carefully controlled when used industrially as in Fig. 2.

FIG. 4—Hundreds of standard samples analyzed by precision methods. Such a group of samples is absolutely necessary for spectrographic analyses for trace elements.

Copper

Copper of a high degree of purity has been a regular article of commerce for many years. It has been regular practice to analyze copper of 99.9+ per cent purity for the presence of some eight or ten different trace elements. This practice was found necessary in connection with the question of electrical conductivity of copper. Very often the effect of these trace elements on properties other than electrical conductivity is lost sight of. One of the outstanding examples of the harmful effects of trace elements in a parent metal of otherwise high degree of purity is the case of traces of bismuth in copper. Bismuth to the extent of 0.002 to 0.004 per cent in copper seriously interferes with its workability. Not only is it difficult or practically impossible to work copper economically with these amounts of bismuth present, but, if copper of this kind is used in the making of brass which is to be hot and cold worked, it is found that this amount of bismuth is ruinous to the brass. Besides bismuth and besides the eight or ten other trace elements ordinarily considered as likely to be present in copper and ordinarily analyzed for, there are a number of other trace elements present whose specific effects are as yet too little known.

Nickel

Nickel is a good example of a parent metal in which both harmful and beneficial trace elements are of considerable importance. The American Society for Testing Materials' specifications for electrolytic nickel specify a maximum of 0.02 per cent of sulphur permissible. Sulphur is acknowledged as an objectionable trace element due to its tendency to form a low melting sulphide which is distributed as thin films around the grain boundaries of the nickel. It has been found that magnesium is a beneficial trace element in nickel in a peculiar fashion. Apparently the primary effect of magnesium is not on the nickel itself but on the shape and occurrence of the sulphide present in the nickel. The sulphides are changed from intergranular films to round globular occlusions which do not seriously affect the workability of the nickel. The addition of 0.01 to 0.02 per cent of magnesium to nickel is thus decidedly beneficial when sulphur difficulties are encountered.

Aluminum

In the aluminum industry there are numerous cases of the enormous importance of trace elements. It is only necessary to cite one of the many. The one selected is the enormous effect of a few thousandths of one per cent sodium on the structure and properties of the aluminum-silicon alloys. Fig. 3 shows a micrograph at 250 magnification of a complex aluminum-silicon alloy containing around 12 per cent of silicon and other alloying additions and less than 0.001 per cent of sodium. The same figure shows a micrograph of this same alloy to which sodium has been added to the extent of 0.005 per cent. It will be seen immediately that the microstructure has been completely altered. The alloys are otherwise identical and the samples were cast in identical fashion so that the only difference so far as can be determined is the sodium addition. This sodium addition has not only changed the microstructure but obviously has changed the physical properties of the alloys to a very material degree.

Determination of Trace Elements

There is no one best method for the determination of trace elements in the non-ferrous metals. Various branches of the industry have developed, through the course of years of chemical research, numerous chemical methods for the determination of many of the trace elements encountered in these base metals. A majority of these chemical methods are apparently of adequate precision and accuracy although in many cases they

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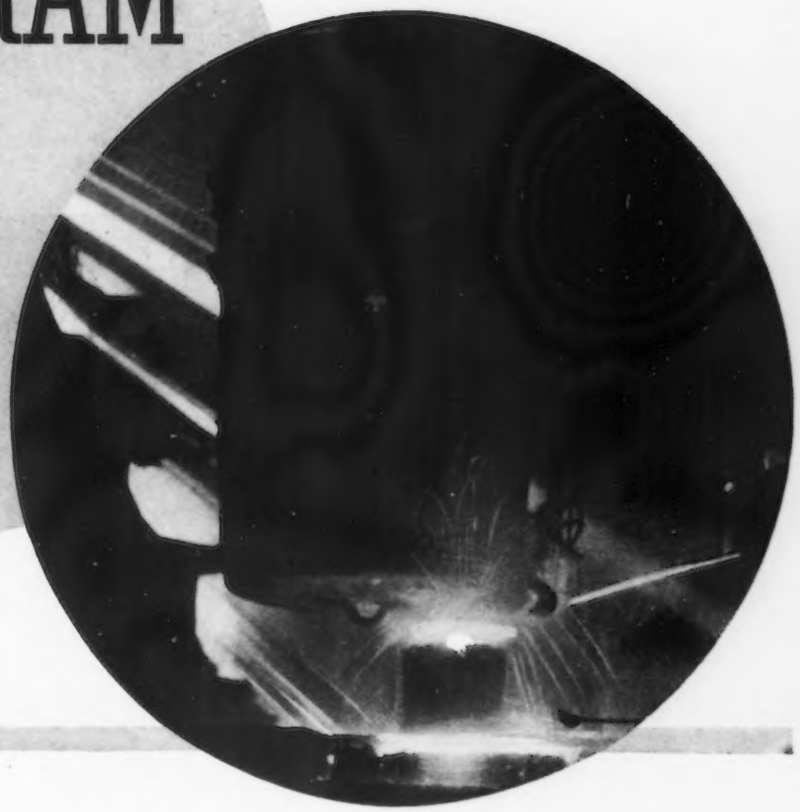

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are not very economical either in time or labor.

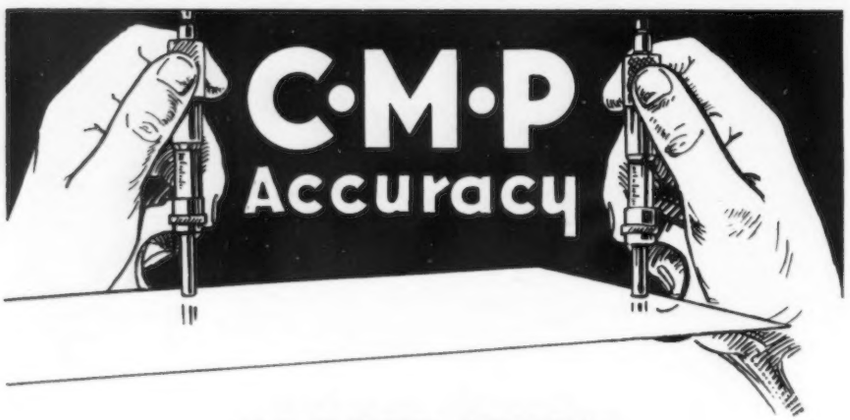
Methods of chemical analysis in general can be divided into the three classes—gravimetric, volumetric and colorimetric. In the gravimetric method the final result is obtained by the actual weighing of a residue or compound or precipitate. In the volumetric method the result is obtained by titration to an end point indicated either by some change in color or change in potential. In colorimetric methods, the amount is determined by an estimation of the depth of color due to the element or a compound of the element.

Spot testing can be considered as part of the field covered by colorimetric methods of chemical analysis. In this special field of spot testing, the amount of solution used is quite small. In some cases, the spot testing of a colorimetric nature is carried out under a microscope and is similar to a qualitative determination made by chemical microscopical methods. Some of the newest and most sensitive quantitative colorimetric reagents are usable in the spot testing technique to make very accurate estimations of trace elements present in fairly small quantities of original sample. By these methods, for example, it is possible to start with a one gram sample and determine the presence of chromium in amounts of 0.0003 per cent.

The spectrograph, however, represents the field in which the greatest advances have been made in methods for the determination of trace elements in non-ferrous metals and alloys. Both the prism type and the grating type of spectrograph are being used successfully commercially and economically. A majority of the trace elements in all of the non-ferrous metals and their alloys may be determined quantitatively by spectrographic means. It is possible to determine many different trace elements practically simultaneously. Quantitative results are obtained within the space of minutes or at the most within but a few short hours, whereas by the various methods of chemical analysis it might often take much longer than this just to get the sample into solution. Quantitative spectrographic analyses for trace elements are being made daily on aluminum, bismuth, chromium, copper, lead, magnesium, nickel, tin, and zinc metals and their alloys.

The spectrograph, however, is not a universal tool destined to replace all chemical laboratories. Certain metalloids such as sulphur and selenium are not readily determined in trace element amounts by spectrographic means. The spectrograph does not offer much promise in the field of quantitative determination of the major base metals present in an alloy in amounts of several per cent. Like "spot testing" the spectrograph is an additional tool for use in learning about "trace elements."

For spectrographic analysis a proper technique must be developed for each type of alloy and certain proper reference standards must be used. Simply having the spectrograph instrument itself without the reference standards is entirely inadequate. Carefully selected and very carefully prepared and analyzed standards are necessary. The spectrograph thus depends on precision chemical analyses as carried out on the standards. Hundreds of such standards each carefully analyzed as to both major constituents and as to one or more trace elements are shown in Fig. 4 (Spectrographic department, Lucius Pitkin, Inc.).



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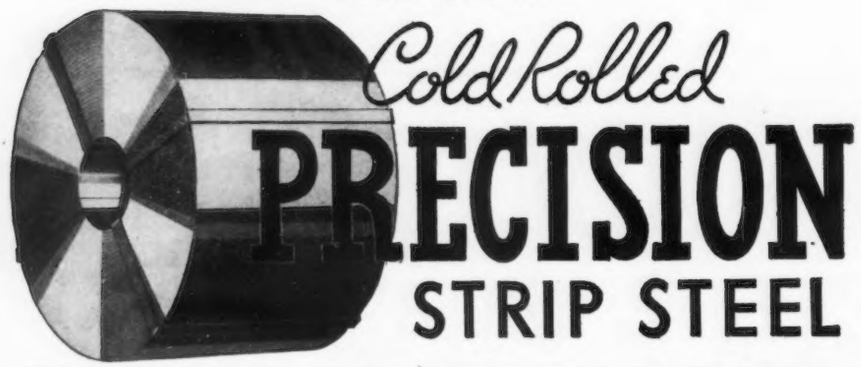


METALS

Developments in heat-resisting steels have made possible many new practical applications where materials must perform at elevated temperatures.

o o o

By C. T. EAKIN

Westinghouse Electric & Mfg. Co.

o o o

IN this article only steels suitable for temperatures where scaling is an important factor have been considered. Taking carbon steel as a base, minimization of scaling by the addition of chromium and the further improvement in strength at high temperatures by the use of nickel in certain proportions are presented. Representative heat-resisting steel compositions with their room temperature, physical properties and typical applications are tabulated herein.

o o o

THE tremendous importance of heat-resisting steels to modern industry is often not fully appreciated. The heat and corrosion-resisting possibilities of these materials were first clearly recognized only a little over two decades ago—originally progress in development and application was slow but during the last 10 years the application of these alloys has expanded with astonishing rapidity.

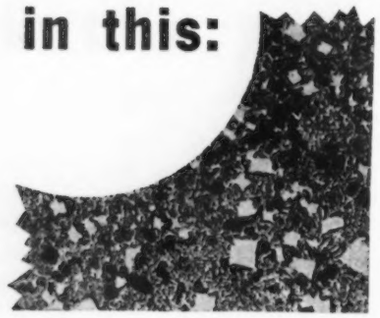
Modern heat-resisting steels have made possible the practical application of many of the recent advances made in metallurgical knowledge. Annealing furnaces, like the one shown on the following page, owe much of their compactness, adaptability, and high efficiency to heat-resisting steels.

Heat-resisting steels may be defined as those steels which resist deformation, corrosion and structural changes at elevated temperatures better than carbon steels. They may be classified according to application into the following groups: (a) those intended for service at temperatures above 1100 deg. F, and (b) those alloys intended for service below 1100 deg. F. This grouping is chosen because of the very important part played by scale formation in the performance of heat-resisting steels and alloys. In both groups the ability to sustain loads at an elevated temperature for a satisfactory length of time without objectionable deformation is one of the primary requisites—but in group (a) scale is very important while in group (b) it is not a serious problem. Only the former group will be considered in this article.

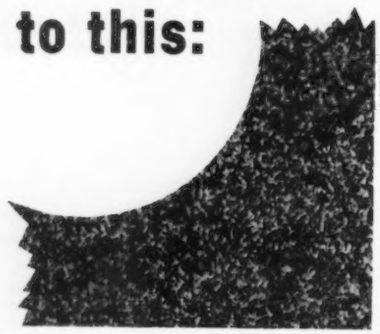
Heat-resisting steels for group (a) conditions have found their chief applications in furnaces of various kinds. They are used freely in both electrical and fuel-fired furnaces.

Imagine for a moment a piece of carbon steel which has failed in an oxidizing atmosphere at a temperature well within the range of group (a), say 1600 deg. F. Assume also that a certain portion of the steel has been subjected to rapid heating and cooling, while the balance of the part has been maintained uniformly at the high temperature. The loadings may, for instance, be compressive, and the failure take place by the

If your shafts are turning in this:



Change to this:



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buckling of the part subjected to the intermittent heating.

Careful examination of this failure would reveal the following three important facts: (1) The portion exposed to intermittent heating would have become greatly reduced in section, (2) the scale would be observed to have flaked off during each heating and cooling, and (3) the portion held at constant temperature would have scaled heavily, but the scale probably would have remained intact and the effective section of metal would have remained greater in thickness than in the other part.

From observations (1) and (2), it is evident that failure may take place because scaling so reduces the cross-section that it no longer is able to sustain the imposed load. From (3), the conclusion may be drawn that intermittent temperatures are undesirable service conditions and that scale, when it remains on the surface, offers some protection against further scaling.

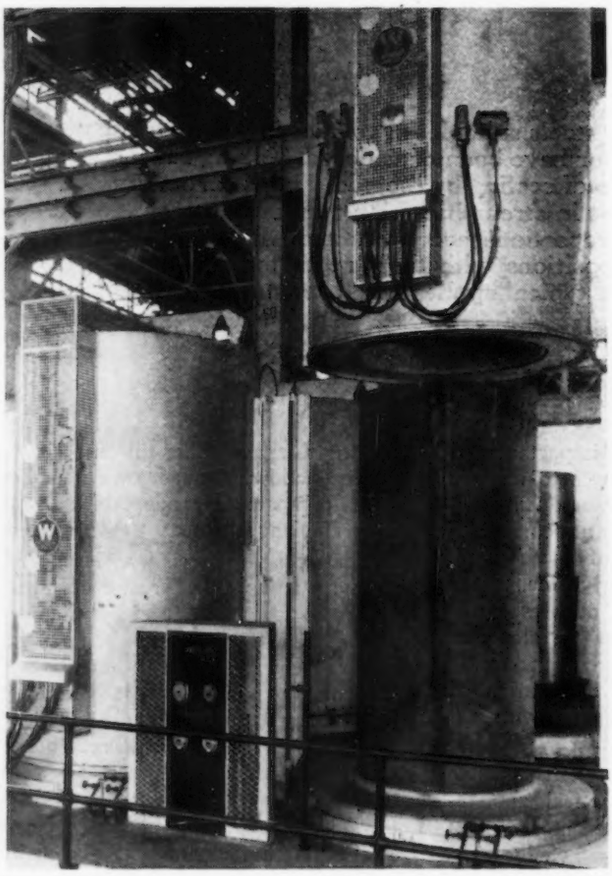
Since failure is the result of scaling, it would seem at first thought that the remedy against failure is to be found in a steel which does not scale. Unfortunately, all of the commercial metallic elements available to the steel manufacturer that might be alloyed with carbon steel form oxides, and most of them tend to oxidize even more readily than carbon steels.

A Scale Blanket

Fortunately, however, the properties of the metallic oxides differ appreciably, and there is the possibility of forcing the scale to "blanket" or protect the underlying metal from further oxidation. In order to give protection to the steel the scale must have certain qualities, among which are (1) imperviousness, to prevent the passage of corrosive gases through the scale to the metal, (2) toughness, so it will not flake off when heated and cooled, (3) adhesiveness, so it will not loosen and fall off, and (4) a high melting point, so the scale will not melt and run off and thus expose fresh metal to the oxidizing gases.

Scaling is a form of corrosion which takes place at elevated temperatures. It is a function of atmosphere and time as well as temperature and composition.

The problem of corrosion at ordinary temperatures is being met today by the use of so-called stainless or rust-resisting steels, in which the constituent responsible for corrosion re-



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THE cylinder (lower right) is made of a straight-chromium steel listed in Table I. An austenitic steel casting of the type listed in Table II is to be seen in the extreme lower right, forming the base for a furnace used to anneal steel strip.

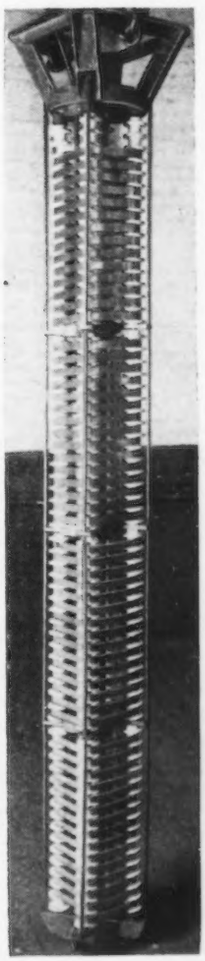
o o o

sistance is chromium. Stainless steels owe their corrosion resisting property to the formation at ordinary temperatures of a thin, tough, adhesive, insoluble and impervious layer of chromium oxide on the surface of the steel, which automatically protects it from further oxidation. Fortunately, chromium imparts desirable qualities to the scale which forms at elevated temperatures as well as to the scale (oxide film) which forms at ordinary temperatures.

Although small additions of chromium to steel improve the qualities of the scale, it is not until a chromium content upwards of 12 per cent is reached that the steels may be classed as scale resistant above 1100 deg. F. Beginning with this composition a rapid increase in scale resistance occurs. The most impervious self-healing oxide layer requires at least 17 per cent chromium.

Chromium Is Master Element

Chromium is the master element among heat-resisting steels. Aluminum and silicon, for example, when present in certain restricted amounts,



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THIS central heating element of the furnace shown on opposite page illustrates the use of heat - resisting steels. The castings at the top and bottom, the support rods, the spacers and the centrifugally cast tube (not visible) are all of the austenitic steels of Table II. The resistor ribbons are of the 80 per cent nickel-20 per cent chromium type of alloy.

o o o

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TABLE I

Three Heat-Resisting Steel Castings of the Straight-Chromium Type

Analysis	No. 1	No. 2	No. 3
Carbon	0.15 max.	0.30 max.	0.25 to 0.50
Chromium	11.5 to 14.0	17.0 to 21.0	26.0 to 30.0
Manganese	0.25 to 0.75	0.25 to 0.75	0.25 to 0.75
Nickel	0.80 max.	1.0 max.	3.0 max.
Silicon	1.0 max.	1.0 max.	0.80 max.
Copper	.....	0.90 to 1.20*	.....
Phosphorus	0.05 max.	0.05 max.	0.05 max.
Sulphur	0.05 max.	0.05 max.	0.05 max.
Physical Properties			
Tensile strength (lb. per sq. in.)	80,000	90,000	55,000
Yield point (lb. per sq. in.)	50,000	55,000	40,000
Elongation in 2 in. (per cent)	20	5	.....
Reduction in area (per cent)	30	5	.....
Brinell hardness, max.	215	230	230
Scale resistant, up to, deg. F.	1500	1700	2100

* Composition No. 2 containing 1 per cent copper is said to be less subject to rapid grain growth and embrittlement on extended heating above 1200 deg F. than the same composition without copper.

improve the scale characteristics when added separately or along with chromium. However, contents of these elements must be limited to narrow ranges on account of their effects upon physical properties. In the case of chromium, on the other hand, steels of useful mechanical characteristics are obtained throughout the full range from 0 to 30 per cent of the element. Some of these steels are used to resist oxidation and sulphidizing atmospheres at temperatures up to approximately 2100 deg. F.

It was pointed out in an earlier paragraph that intermittent thermal changes are very unfavorable conditions with respect to the life of carbon steel at elevated temperatures. The same is true to a much less extent in the case of the heat-resisting steels. Their life under conditions of intermittent heating depends upon such factors as nature of the atmosphere, steel composition, temperature and rate of temperature change, the latter being especially important in the case of the lower chromium steels.

Tendency to Absorb Carbon

The straight-chromium heat-resisting steels tend to absorb carbon from carburizing atmospheres, which results in a deleterious effect upon the mechanical properties at lower temperatures. Some of these steels also have an inherent tendency to develop low impact properties at atmospheric temperatures after holding in the temperature range of 750 to 1000 deg. F. Brittleness from this cause may be somewhat relieved by heating to a

TABLE II

SIX HEAT-RESISTING AUSTENITIC ALLOY CASTINGS

Composition*	No. 1†	No. 2	No. 3	No. 4	No. 5	No. 6
Carbon	0.07 to 0.20	up to 0.40	up to 0.40	up to 0.60	up to 0.35	up to 0.60
Chromium	18.0 to 21.0	22.0 to 26.0	23.0 to 27.0	26.0 to 30.0	8.0 to 11.0	14.0 to 17.0
Nickel	8.0 to 10.0	11.0 to 13.0	19.0 to 22.0	8.0 to 10.0	19.0 to 22.0	34.0 to 37.0
Manganese	0.40 to 0.70	0.25 to 1.0	0.25 to 1.0	0.25 to 1.0	0.25 to 1.0	0.25 to 1.0
Silicon	0.50 to 1.0	0.25 to 1.5	0.25 to 1.5	0.25 to 1.5	0.25 to 2.0	0.50 to 1.75
Phosphorus	0.045 max.	0.05 max.	0.05 max.	0.05 max.	0.05 max.	0.05 max.
Sulphur	0.045 max.	0.05 max.	0.05 max.	0.05 max.	0.05 max.	0.05 max.
Physical Properties						
Tensile strength	65,000 to 80,000	70,000	72,000	85,000	65,000	60,000
Yield point	30,000 to 40,000	31,500	32,400	38,250	29,250	27,000
Elongation	45 to 65	30	25	6	30	..
Reduction in area	45 to 65	30	25	6	35	..
Brinell hardness		200	225	225	..	185
Scale resistant up to, deg. F.**	1650***	2000	2100	1900	1800	1900
Applications	Fittings in oil refinery high-temperature service, baffles, air preheaters.	Normalizing shaft disks, walking beam furnace parts, support brackets, annealing boxes.	Annealing boxes, furnace doors, skids, heat exchangers, heating tubes, carburizing boxes, rider sheets.	Similar to No. 1, except it resists sulphur-bearing atmosphere better.	Furnace parts, heat treating trays, certain controlled atmosphere furnace parts.	Furnace muffles, carburizing containers, lead pots, cyanide pots, furnace pots.

* In Tables I and II the compositions given conform very closely with those given in A.S.T.M. Tentative Standards for 1935.

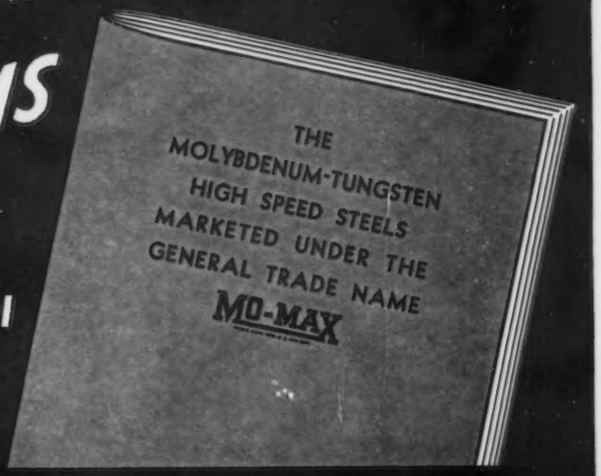
** The temperatures given are intended as a guide for ordinary furnace atmospheres at continuous temperatures. Intermittent temperatures and various atmospheres may greatly lessen the service life.

*** For temperatures between 800 and 1500 deg. F. carbide instability should be taken care of by extremely low carbon or titanium or columbium.

† Physical properties for composition No. 1 are from material quenched from 2000 deg. F.

PRODUCTION PROBLEMS ARE LARGELY TOOL PROBLEMS

. . . and the principal tool problem is the STEEL PROBLEM



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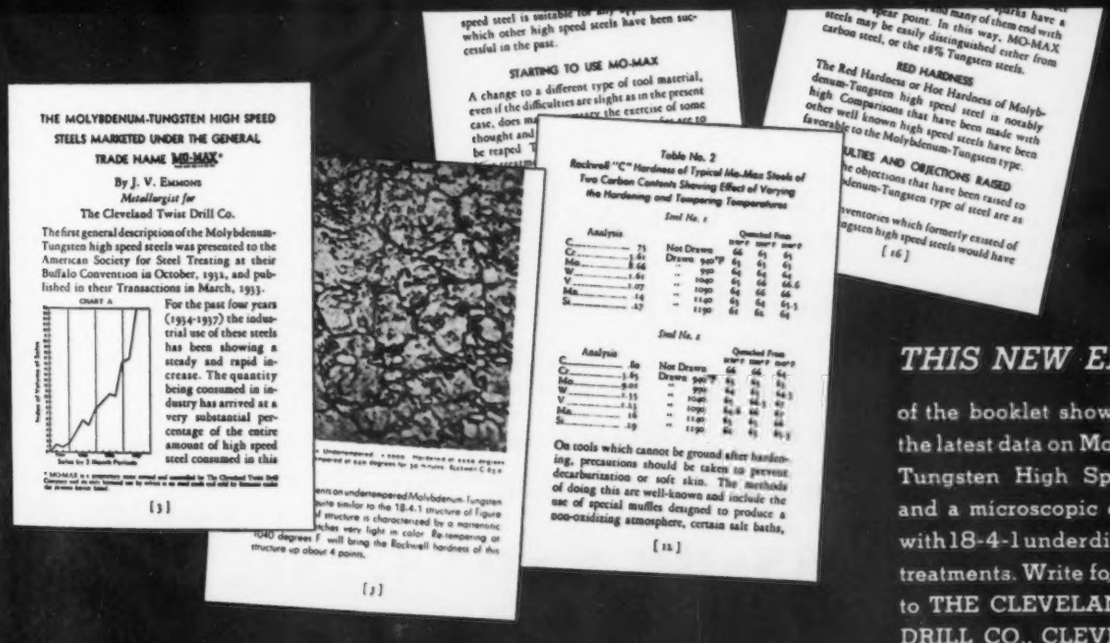

THE MOLYBDENUM-TUNGSTEN HIGH SPEED STEELS MARKETED UNDER THE GENERAL TRADE NAME MO-MAX*

By J. V. Emmons
Metallurgist for
The Cleveland Twist Drill Co.

The first general description of the Molybdenum-Tungsten high speed steels was presented to the American Society for Steel Treating at their Buffalo Convention in October, 1932, and published in their Transactions in March, 1933.

For the past four years (1934-1937) the industrial use of these steels has been showing a steady and rapid increase. The quantity being consumed in industry has arrived at a very substantial percentage of the entire amount of high speed steel consumed in this

CHART A

[3]

speed steel is suitable for ... which other high speed steels have been successful in the past.

STARTING TO USE MO-MAX

A change to a different type of tool material, even if the difficulties are slight as in the present case, does ma... thought and ... be reaped ...

[7]

... many of them end with ... steels may be easily distinguished ... carbon steel, or the 18% Tungsten steels.

RED HARDNESS

The Red Hardness or Hot Hardness of Molybdenum-Tungsten high speed steel is notably high. Comparisons that have been made with other well known high speed steels have been favorable to the Molybdenum-Tungsten type.

...ULTIES AND OBJECTIONS RAISED

...e objections that have been raised to ...denum-Tungsten type of steel are as ...

...ventories which formerly existed of ...gsten high speed steels would have

[16]

Table No. 2

Rockwell "C" Hardness of Typical Mo-Max Steels of Two Carbon Contents Showing Effect of Varying the Hardening and Tempering Temperatures

Steel No. 1

Analysis	Not Drawn	Quenched From 1900° F	1950° F	2000° F
C ..... .75		64	65	65
Cr 3.61	Drawn 500° F	63	63	63
Mo 8.66	" 900	64	64	64
W 1.61	" 1040	65	66	66.5
V 1.07	" 1090	64	66	66
Mn ..... .14	" 1140	63	64	64.5
Si ..... .27	" 1190	61	64	64

Steel No. 2

Analysis	Not Drawn	Quenched From 1900° F	1950° F	2000° F
C ..... .80		66	66	64
Cr 3.65	Drawn 500° F	65	65	65
Mo 8.60	" 900	64	65	64.5
W 1.55	" 1040	63	64.5	67
V 1.15	" 1090	64.5	66	67
Mn ..... .18	" 1140	63	65	66
Si ..... .19	" 1190	61	63	63.5

On tools which cannot be ground after hardening, precautions should be taken to prevent decarburization or soft skin. The methods of doing this are well-known and include the use of special muffles designed to produce a non-oxidizing atmosphere, certain salt baths,

[12]

... Undertempered ... hardened at 2000 degrees ... tempered at 600 degrees for 30 minutes Rockwell C 63.5

... ments on undertempered Molybdenum-Tungsten ... ture similar to the 18-4-1 structure of Figure ... structure is characterized by a martensitic ... hes very light in color. Re-tempering at 1040 degrees F will bring the Rockwell hardness of this structure up about 4 points.

[5]

THIS NEW EDITION

of the booklet shown contains the latest data on Molybdenum-Tungsten High Speed Steels and a microscopic comparison with 18-4-1 under different heat treatments. Write for your copy to THE CLEVELAND TWIST DRILL CO., CLEVELAND, O.

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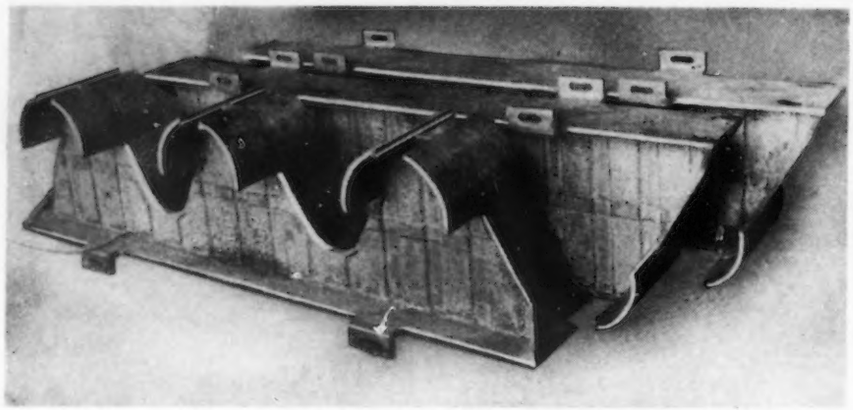

AUSTENITIC steel castings of Table II used for wire coil supports in annealing furnaces. Courtesy of the Calorizing Co.

temperature of 1450 deg. to 1500 deg. F. just before cooling to atmospheric temperatures.

The term "chromium heat-resisting steels" is frequently used in the trade to include low-carbon alloys of iron and chromium having a chromium content from about 12 to 30 per cent. The steels containing a maximum of 0.12 per cent carbon and a chromium within the range of about 16 to 30 per cent are more properly called chromium irons. They do not respond to hardening by quenching.

Typical straight-chromium heat-resisting steel castings are listed in Table I. Practically the same compositions are used for the wrought materials except that the carbon is held to a somewhat lower content. Composition No. 1 responds to hardening and grain refinement by quenching, while compositions No. 1, 2 and 3 are of the chromium-iron type.

The temperatures given are intended as a guide for ordinary oxidizing furnace atmospheres at continuous temperatures. For intermittent temperatures or other atmospheres, the allowable temperatures for the same life may vary greatly.

Riveting Recommended

Welding is not usually practiced on the straight-chromium steels of Table I on account of the brittleness at room temperature which accompanies the coarse grain structure formed in the material adjacent to the weld. Except in the case of steel No. 1, the coarse structure when once formed cannot be refined by heat treatment. Under certain circumstances welding may be permissible when the service is free from shock at room temperature, but for the great majority of applications riveting is the usual method of fabrication.

In an earlier paragraph "resistance to structural changes" was mentioned

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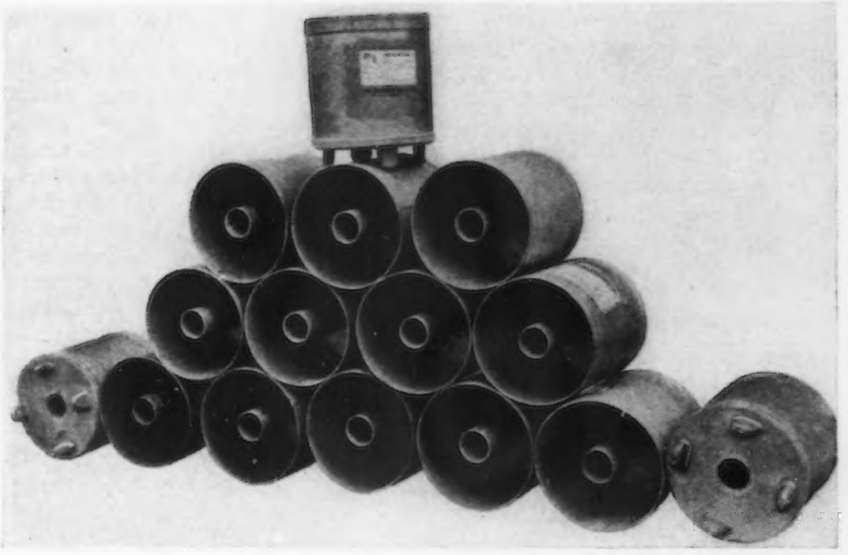
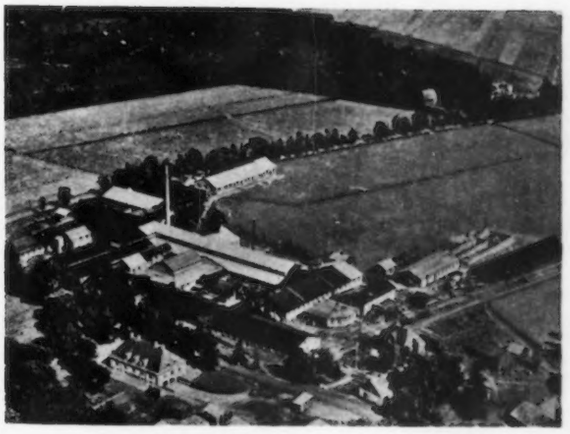
as a desirable characteristic of heat-resisting steel. By "structural change" was meant changes in the atomic arrangement, one manifestation of which is the formation at elevated temperatures of coarse grains. This has been mentioned as one of the objectionable characteristics of chromium steels, chiefly because it is accompanied by brittleness at room temperatures.

Another manifestation of structural change is that which takes place in what is known as the critical temperature range. The atomic structure of iron, which is the base for all heat-resisting steels, consists, at ordinary temperature, of a grouping in which each corner of a cube is occupied by an atom and another atom is located where the diagonals of the cube cross. This is called the body-centered cubical arrangement. When heated through the critical range a rearrangement of the atomic structure takes place. One atom is located at each of the eight corners of a cube, but an atom is now located at the intersection of each of the diagonals of the faces of the cube. This system is called the face-centered cubic arrangement. This change is important to the user of heat-resisting steels chiefly because it is accompanied by a volume change, a pronounced loss of creep strength and a great increase in solubility of carbon above the critical range. The temperatures at which these transformations take place vary considerably with the



THESE carburizing boxes are made from rolled austenitic steel of one of the compositions given in Table II. Photo by Crucible Steel Co. of America.



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amount and nature of the alloying elements which are added. It happens that nickel has a strong tendency to lower the critical range. By adding enough nickel to the composition the critical range can be suppressed below room temperatures, resulting in the well-known austenitic steels listed in Table II. Since no critical range is encountered in heating these steels from room to operating temperatures, the objectionable features incident to the critical range are eliminated.

Typical compositions and physical properties of nickel-chromium steel castings are given in Table II. As in the case of the straight-chromium steels, the compositions of the wrought materials are practically the same as those of the castings except that lower carbon is maintained. These steels are austenitic and, therefore, non-magnetic, and do not respond to hardening or grain refinement by quenching. Under certain conditions of temperature there is a tendency for carbides to separate along the grain boundaries, somewhat affecting toughness and rendering the steels sensitive to intergranular corrosion. This can be controlled by the use of extremely low carbon, by a stabilizing treatment, or by the addition of certain elements such as titanium or columbium to the composition. The choice of method depends to a great extent upon the service conditions.

No Embrittlement When Welded

The high-chromium steels of Table II, compositions No. 1, 2, 3 and 4, are usually preferred where carburization is not a factor and where oxidizing or sulfidizing gases at high temperatures are encountered.

Steel No. 1, Table II, is preeminently a corrosion-resisting steel, and is comparatively little used as a heat resisting material in the higher temperature ranges.

The high nickel steels, compositions No. 5 and 6, are used in oxidizing or carburizing atmospheres in the absence of appreciable amounts of sulphur.

To the compositions given in Table II may be added other alloying elements such as aluminum, silicon, columbium, titanium, tungsten, molybdenum and others. The first two elements mentioned contribute mainly to scale resistance, the second two to carbide control, and the last two to creep strength at the high temperatures.

The steels of Table II may be joined by welding without danger of

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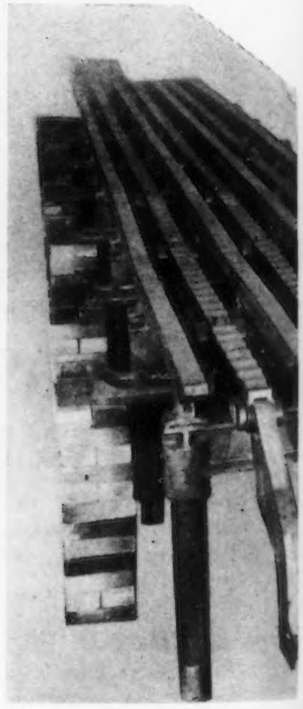

HEAT - RESISTING steels of fuel-fired furnace of the for continuous operation.

the severe embrittlement encountered in welding the steels of Table I. The gas and spot weld methods are generally used for gages 1/16 in. and lighter, while the electric arc method is used for heavier gages. For the latter method coated rods of practically the same composition are used.

Deeper Draws Without Annealing

The steels of Table I and II, in the wrought form, lend themselves to cold drawing, forming and bending. Those of Table II, as a class, have much greater ductility than those of Table I, hence deeper draws can be made without annealing although they work harden much more rapidly than the steels of Table I. The steels of Table II are also characterized by their low proportional limits, high tensile strengths at room temperatures, and marked increases in strength and hardness when subjected to cold work.

Each application for heat-resisting steels is accompanied by its peculiar conditions, and it is only with a thorough understanding of all the conditions of service and the response of the alloys to those conditions that an intelligent choice of steels can be made. In view of the many variables to be encountered in most applications, it is usually very advantageous for the user and manufacturer of the steel to co-operate in the choice of the steel for each new application.

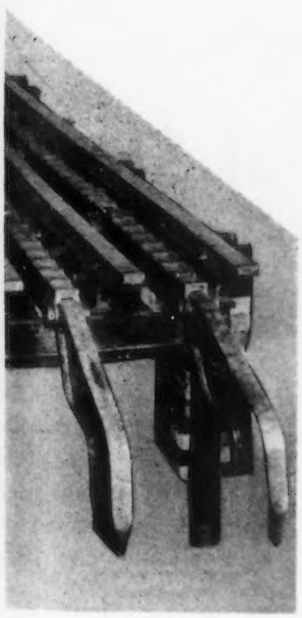

Table II used for parts for a automatic walking beam type Courtesy of the Calorizing Co.

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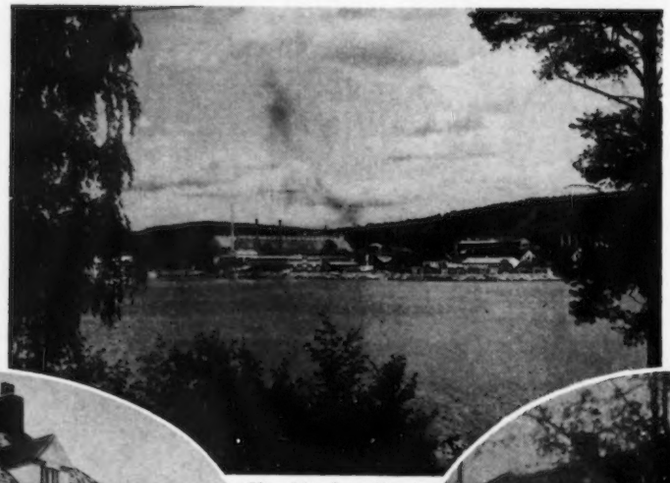

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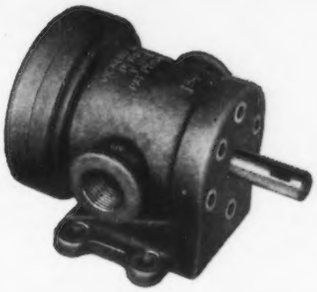
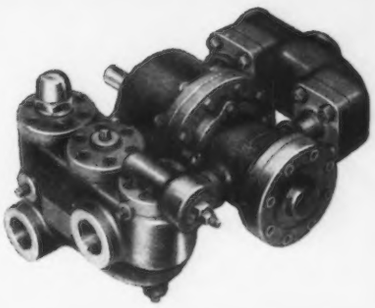
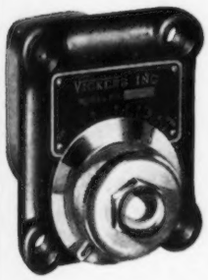


VICKERS Balanced Vane Type Rotary Pump for continuous working pressures up to 1,000 lb. per sq. in.



VICKERS Double Pump and Combination Valve Assembly delivers large volume at low pressure and small volume at high pressure.



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VICKERS Balanced Gear Fluid Motor provides efficient and compact variable speed rotary drives.

VICKERS Variable Delivery Pumps for working pressures to 2,500 lb. per sq. in. Many modifications available.

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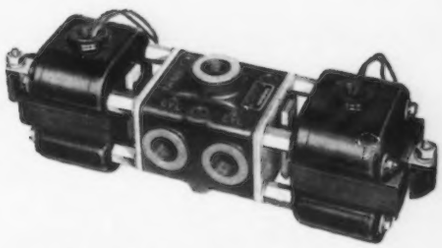

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MACHINE Tools

Refinements noted in design, strength of construction, speeds, accuracy and capacities.

o o o

By FRANK J. OLIVER
Associate Editor, THE IRON AGE

o o o

FEW radical changes are to be found in the shop equipment introduced by the machine tool builders during the past year, but many detailed changes in design are to be noted, such as the use of better materials and sturdier construction, heat-treated parts and the use of precision anti-friction bearings, resulting in greater accuracy and longer life of parts. With the wider use of cemented carbide tools, available speeds are being extended into the higher range. There are extensions in size capacity as well. Some records have been broken as to size and precision features have been extended to some very large pieces of equipment. On the other hand, the honing technique is available now down to bores of ¼-in. diameter, and high-speed sensitive drills can drill a hole 0.002 in. in size.

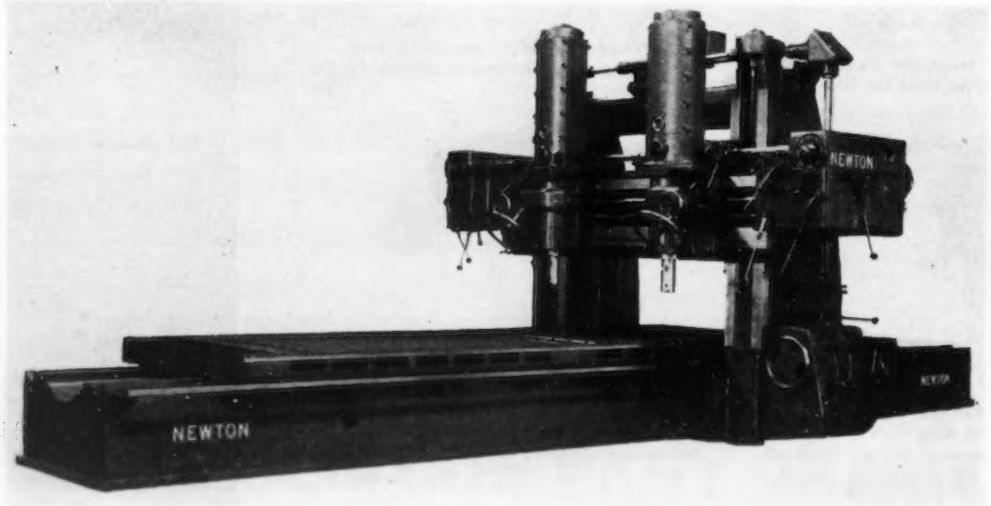
The plain bearing has practically passed out of the picture as a spindle mount and in its place we find the preloaded roller or ball bearing. Sliding gears on spline shafts carried in anti-friction bearings also predominate in drives. V-belts as a motor connection are coming into more and more use, frequently involving ingenious variable-speed features, but there are a number of applications of direct motor drive that are outstanding, including an electric high-speed turret lathe.

It is not surprising to find a great deal of attention being paid to grinding machines, as close tolerances become more general. More descriptions are to be found under various grinding machine heads than any other. For similar reasons, a number of developments were made in gear finishing equipment, employing both shaving and lapping methods. In this connection, though not strictly speaking a machine tool, a machine and technique for flame hardening gear teeth was one of the leading developments of the year and is being applied by machine tool builders themselves in the construction of their products.

Further application is found of the unit-head principle to way and other machines, particularly for use in the automotive industry, and this review can content itself only with picking a few random samples. The unit head idea has been extended into the field of milling as well as in the well recognized field of boring and drilling.

Considerable progress has been made in hydraulic power application, in several instances to chucking of large work and generally in connection with corresponding electrical interlocks. Many machines, on the other hand, have complete electrical control, and the tendency is toward the simplification and centralization of switches and controllers. Automaticity in cycles is being further extended.

Brief digests of specific developments introduced or described in the



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BOTH heads and table of this large size planer-type boring machine are equipped with end measures, inside micrometers and dial indicators for such accurate work as boring roller bearing fits in printing press frames.

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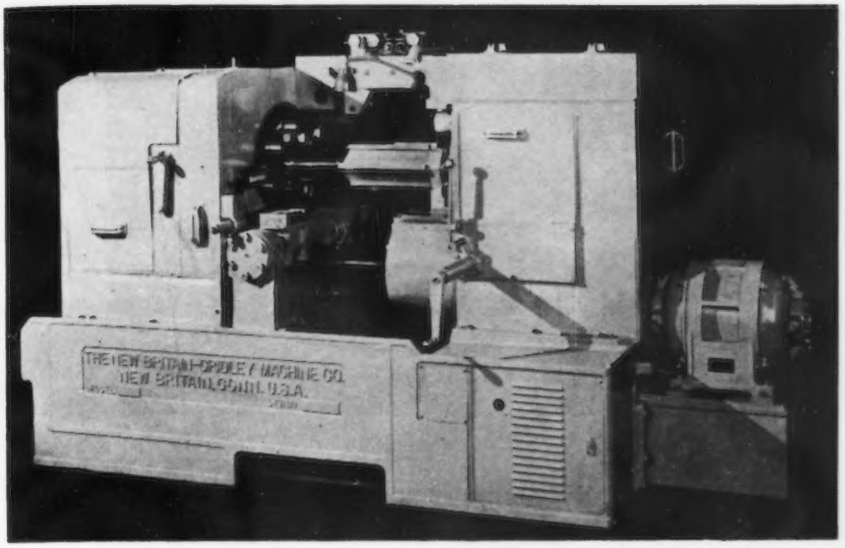


AMONG the features of this New Britain-Gridley six-spindle automatic chucking machine are the hydraulic chucks with automatic feed throwout should the pressure fall below a set amount.

past year follow, and for convenience are grouped alphabetically according to recognized machine tool classifications.

Boring Machines

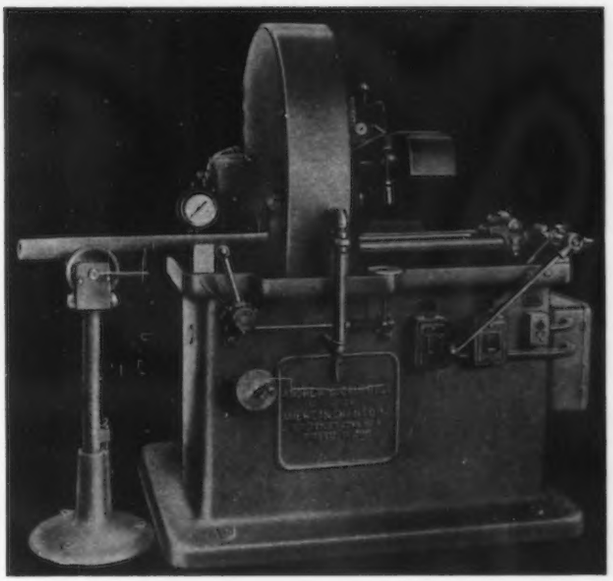
For precision drilling and boring operations on large castings, the *Newton* division of the *Consolidated Machine Tool Corp.*, Rochester, N. Y., brought out a machine in which both vertical boring heads are provided with handwheels for precision positioning and with end measures, inside micrometers and dial indicators. The boring bars have power rapid traverse vertically and the heads rapid traverse across the rails. Power feed and traverse are provided the rail and the table. Large dials show spindle revolutions and feeds. The table is built in two sections which can be used separately.

The year 1937 saw the entrance of a new company in the jig borer field, the *Cleveland Universal Jig Co.*, which brought out a unit featuring rigidity, accuracy and ease of control in its type 48 precision jig borer. Table longitudinal feed screw is fitted with a vernier dial, and in addition, a vernier slide runs the full length of the table. The crossrail is similarly provided. The spindle is driven by a 7½-hp. New Departure Transitorq variable-speed motor and for higher speeds, V-belt drive is employed.

on the smaller sizes and 17 to 25 ft. on the larger. In these machines, the hydraulic piston and rod are securely anchored to the bed under the pulling slide, and the long combination cylinder and slide is guided by hardened steel ways.

The same design principle of fixed piston is incorporated in a vertical pull-down machine made by American Broach. Stroke length can be adjusted up to 22 in. Hydraulic power is supplied by a Sundstrand unit driven by V-belts.

Among the unusual broaching machines built in the last year was an adaptation of a standard 60-in. stroke, 15-ton pull-up type built by *Colonial Broach Co.* The particular job was



o o o

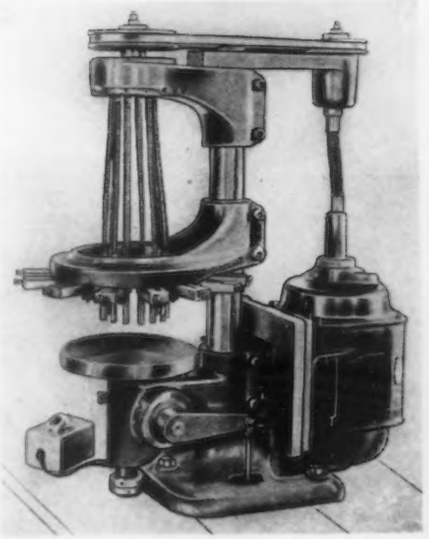
IN this the Campbell "Cutamatic" the arc of contact remains the same regardless of the thickness of stock by means of a combination of oscillating and rotating increments of the hydraulically fed abrasive cutting wheel.

o o o

Broaching Machines

The increasing popularity of broaching has led to the development of some universal types of machines of medium size. The *Colonial Broach Co.*, Detroit, for example, introduced a universal hydraulic broaching machine designed for pull-type broaching. It is adaptable for surface broaching, round or splined holes, helical or straight keyways and the like. The machine comes in strokes of 48 and 60 in. and in capacities of 6, 10, 15 and 20 tons. Bases are of welded steel.

American Broach & Machine Co., Ann Arbor, Mich., has developed a similar series of horizontal broaches in seven sizes, known as type H. Normal capacities range from 6 to 20 tons, in stroke lengths of 36 and 60 in. Cutting speeds are 10 to 28 ft. per min.



INDEPENDENT adjustment is provided the 12 spindle boxes of this multiple spindle bench drill made by the Automatic Machine Co., featuring flexible shaft drive from the drive head.

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The almost limitless resource and flexibility of Vickers Hydraulic Control sets the machine designer free from the most irksome of shackles.

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Vickers Hydraulic Control enables you to meet demands for the most complex controls and motions with relative simplicity. It enables you to provide any desired thrust at any given point—and with any practicable speed of movement. It takes the shackles off the designer —enables him to deal effectively with any number of problems formerly elusive.

And it provides for tremendous improvement in any machine to which it is applicable. Machines equipped with it turn out more and better work—are far easier to operate.

Whatever line of designing you deal with, you should have in your files data on the Vickers Hydraulic Controls suitable for your work. Write for latest information, briefly outlining your type of work.

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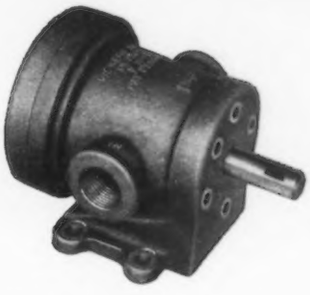
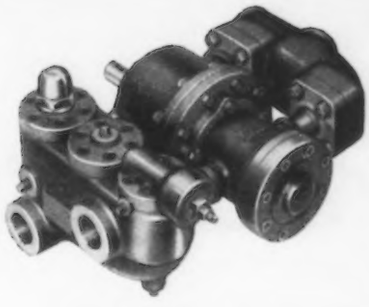


VICKERS Balanced Vane Type Rotary Pump for continuous working pressures up to 1,000 lb. per sq. in.



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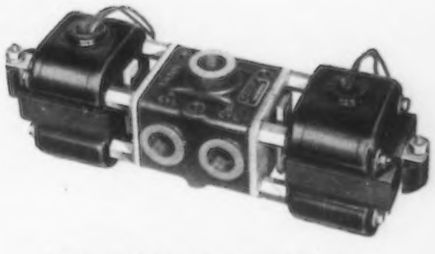

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- Balanced Vane Type
- Balanced Gear Type
- Multiple Piston Type

PRESSURE CONTROLS
- Relief Valves
- Unloading Valves
- Sequence Valves
- Reducing Valves
- Pressure Switches

VOLUME CONTROLS
- Adjustable Flow Valves
- Metering Valves
- Flow and Overload Relief Valves
- Deceleration Valves
- Time Delay Valves

DIRECTIONAL CONTROLS
- 2-, 3-, 4-, 5-, and 6-W Valves
- Manual, Pilot and Soleno Types
- Shut-Off Valves
- Pilot and Pilot Interlock Valv
- Check and Prefill Check Valv

CONTROL ASSEMBLIES
- Traverse and Feed Panels
- Reciprocation Panels
- Special Purpose Panels
- Multiple Unit Valves
- Accumulators and Power Uni

FLUID MOTORS
- Constant Displacement
- Variable Displacement
- Balanced Gear Type
- Multiple Piston Type
- Cylinders

VICKERS *Incorporated* · 1420 OAKMAN BOULEVARD, DETROIT, MICHIGAN

MACHINE Tools

Refinements noted in design, strength of construction, speeds, accuracy and capacities.

o o o

By FRANK J. OLIVER
Associate Editor, THE IRON AGE

o o o

FEW radical changes are to be found in the shop equipment introduced by the machine tool builders during the past year, but many detailed changes in design are to be noted, such as the use of better materials and sturdier construction, heat-treated parts and the use of precision anti-friction bearings, resulting in greater accuracy and longer life of parts. With the wider use of cemented carbide tools, available speeds are being extended into the higher range. There are extensions in size capacity as well. Some records have been broken as to size and precision features have been extended to some very large pieces of equipment. On the other hand, the honing technique is available now down to bores of ¼-in. diameter, and high-speed sensitive drills can drill a hole 0.002 in. in size.

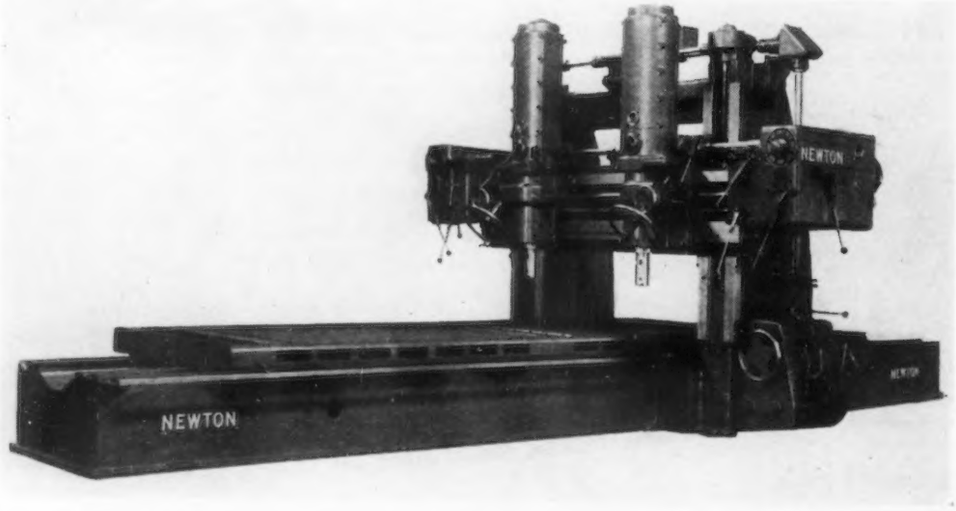
The plain bearing has practically passed out of the picture as a spindle mount and in its place we find the preloaded roller or ball bearing. Sliding gears on spline shafts carried in anti-friction bearings also predominate in drives. V-belts as a motor connection are coming into more and more use frequently involving ingenious variable-speed features, but there are a number of applications of direct motor drive that are outstanding, including an electric high-speed turret lathe.

It is not surprising to find a great deal of attention being paid to grinding machines, as close tolerances become more general. More descriptions are to be found under various grinding machine heads than any other. For similar reasons, a number of developments were made in gear finishing equipment, employing both shaving and lapping methods. In this connection, though not strictly speaking a machine tool, a machine and technique for flame hardening gear teeth was one of the leading developments of the year and is being applied by machine tool builders themselves in the construction of their products.

Further application is found of the unit-head principle to way and other machines, particularly for use in the automotive industry, and this review can content itself only with picking a few random samples. The unit head idea has been extended into the field of milling as well as in the well recognized field of boring and drilling.

Considerable progress has been made in hydraulic power application, in several instances to chucking of large work and generally in connection with corresponding electrical interlocks. Many machines, on the other hand, have complete electrical control, and the tendency is toward the simplification and centralization of switches and controllers. Automaticity in cycles is being further extended.

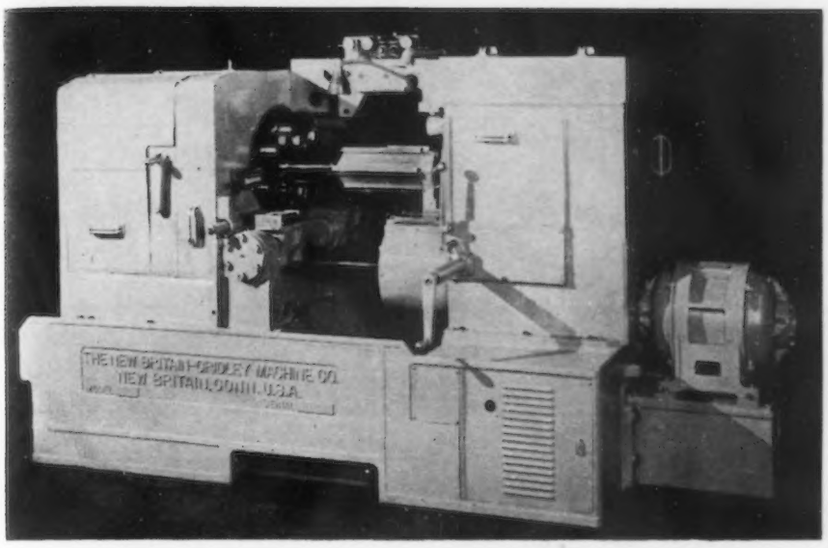
Brief digests of specific developments introduced or described in the



o o o

BOTH heads and table of this large size planer-type boring machine are equipped with end measures, inside micrometers and dial indicators for such accurate work as boring roller bearing fits in printing press frames.

o o o



AMONG the features of this New Britain-Gridley six-spindle automatic chucking machine are the hydraulic chucks with automatic feed throwout should the pressure fall below a set amount.

past year follow, and for convenience are grouped alphabetically according to recognized machine tool classifications.

Boring Machines

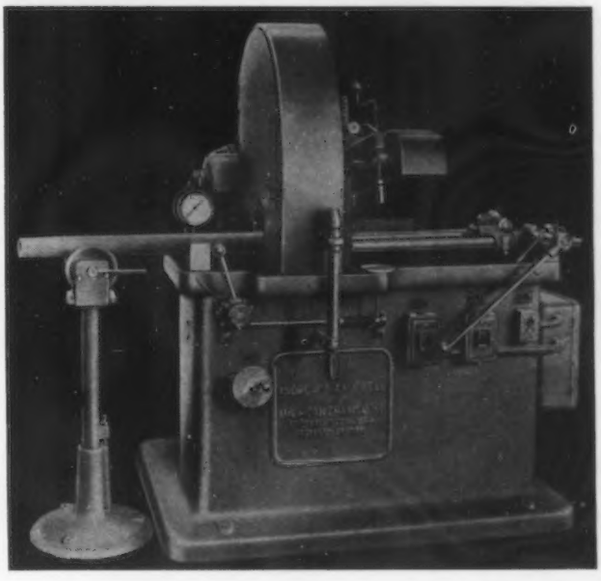
For precision drilling and boring operations on large castings, the *Newton* division of the *Consolidated Machine Tool Corp.*, Rochester, N. Y., brought out a machine in which both vertical boring heads are provided with handwheels for precision positioning and with end measures, inside micrometers and dial indicators. The boring bars have power rapid traverse vertically and the heads rapid traverse across the rails. Power feed and traverse are provided the rail and the table. Large dials show spindle revolutions and feeds. The table is built in two sections which can be used separately.

The year 1937 saw the entrance of a new company in the jig borer field, the *Cleveland Universal Jig Co.*, which brought out a unit featuring rigidity, accuracy and ease of control in its type 48 precision jig borer. Table longitudinal feed screw is fitted with a vernier dial, and in addition, a vernier slide runs the full length of the table. The crossrail is similarly provided. The spindle is driven by a 7½-hp. New Departure Transitorq variable-speed motor and for higher speeds, V-belt drive is employed.

on the smaller sizes and 17 to 25 ft. on the larger. In these machines, the hydraulic piston and rod are securely anchored to the bed under the pulling slide, and the long combination cylinder and slide is guided by hardened steel ways.

The same design principle of fixed piston is incorporated in a vertical pull-down machine made by American Broach. Stroke length can be adjusted up to 22 in. Hydraulic power is supplied by a Sundstrand unit driven by V-belts.

Among the unusual broaching machines built in the last year was an adaptation of a standard 60-in. stroke, 15-ton pull-up type built by *Colonial Broach Co.* The particular job was



o o o

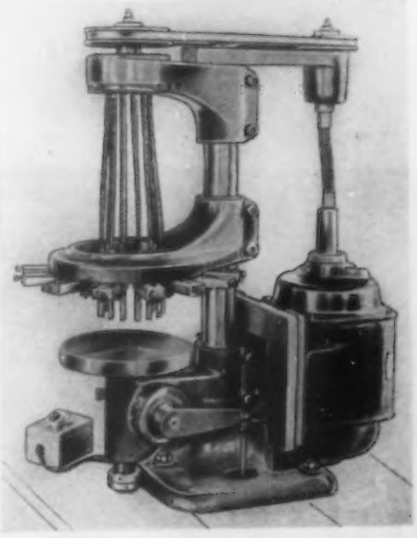
IN this the Campbell "Cutamatic" the arc of contact remains the same regardless of the thickness of stock by means of a combination of oscillating and rotating increments of the hydraulically fed abrasive cutting wheel.

o o o

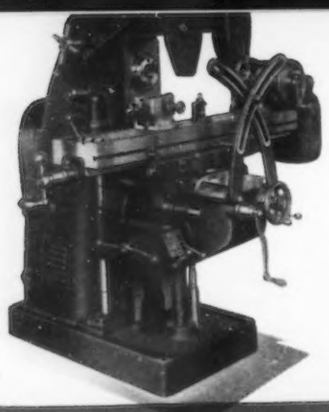
Broaching Machines

The increasing popularity of broaching has led to the development of some universal types of machines of medium size. The *Colonial Broach Co.*, Detroit, for example, introduced a universal hydraulic broaching machine designed for pull-type broaching. It is adaptable for surface broaching, round or splined holes, helical or straight keyways and the like. The machine comes in strokes of 48 and 60 in. and in capacities of 6, 10, 15 and 20 tons. Bases are of welded steel.

American Broach & Machine Co., Ann Arbor, Mich., has developed a similar series of horizontal broaches in seven sizes, known as type H. Normal capacities range from 6 to 20 tons, in stroke lengths of 36 and 60 in. Cutting speeds are 10 to 28 ft. per min.



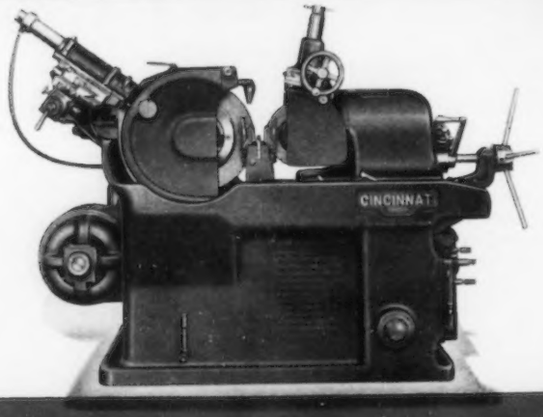
INDEPENDENT adjustment is provided the 12 spindle boxes of this multiple spindle bench drill made by the Automatic Machine Co., featuring flexible shaft drive from the drive head.



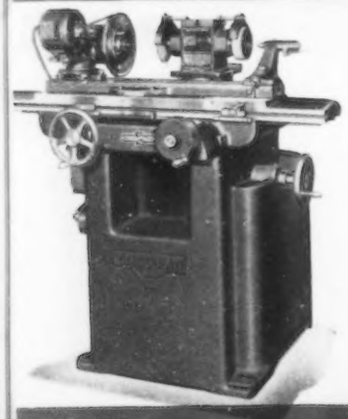
Cincinnati No. 2 MH Universal Milling Machine

Cincinnati No. 3 Plain High-Speed Dial Type Milling Machine

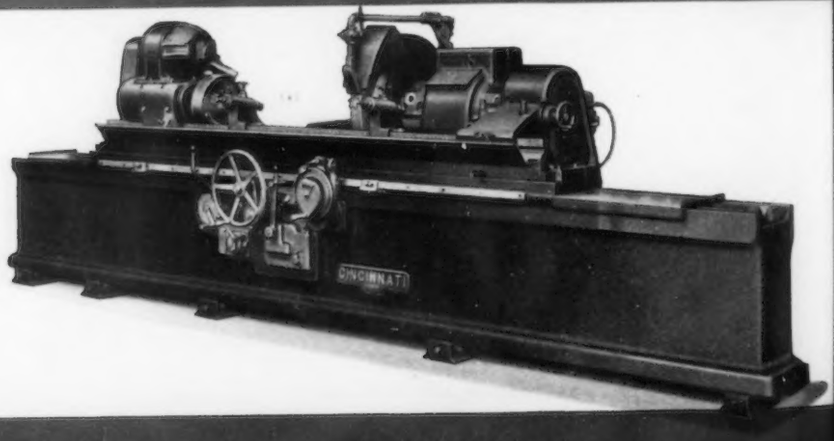
Cincinnati No. 2 Vertical High-Speed Dial Type Milling Machine



Cincinnati No. 2 Centerless Grinding Machine



Cincinnati No. 2 Cutter and Tool Sharpening Machine

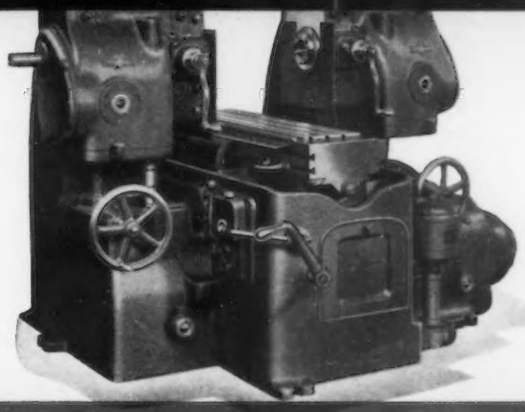


Cincinnati 14"x48" Plain Self-Contained Grinding Machine

Efficiency

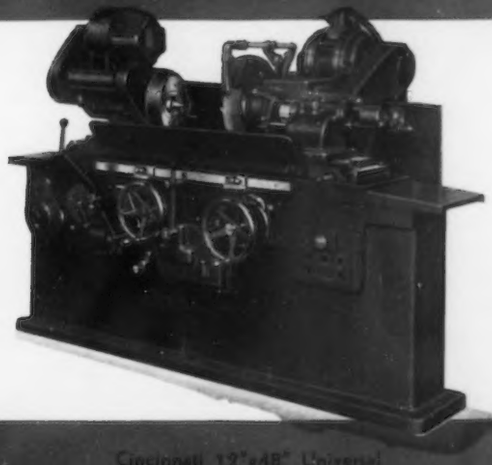
CINCINNATI

A SYMBOL OF A DEFINITE STANDARD OF WORTH



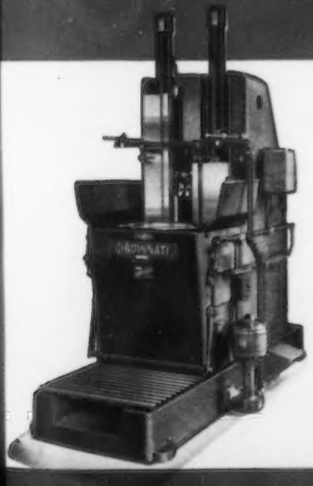
Cincinnati 3-36 Duplex Hydromatic Milling Machine

Cincinnati No. 1-12 Plain Automatic Milling Machine

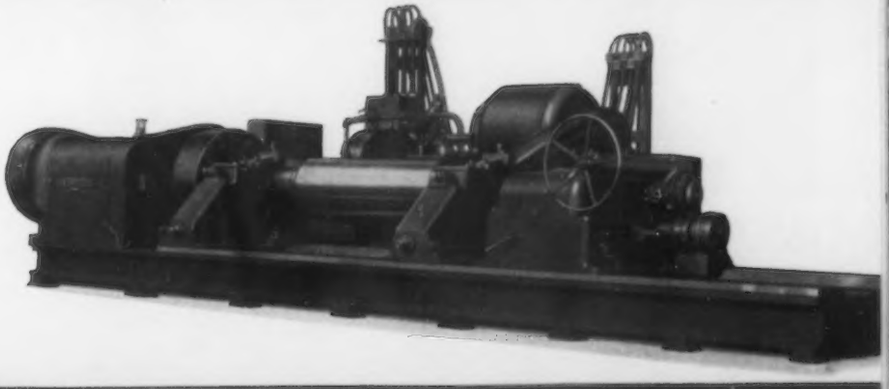


Cincinnati 12"x48" Universal Grinding Machine

Cincinnati 6"x30" Plain Hydraulic Grinding Machine



Cincinnati 2-36 Duplex Vertical Hydro Broach



Cincinnati 36"x192" Roll Grinding Machine

THE common factor in the extensive line of CINCINNATI Machines is . . . efficiency . . . made possible by more powerful drives and faster speeds . . . greater operating conveniences . . . improved safety features and refinements in accuracy reflected in your products. These are the characteristics of the CINCINNATI Machines which will help you meet your 1938 manufacturing cost-reducing requirements.

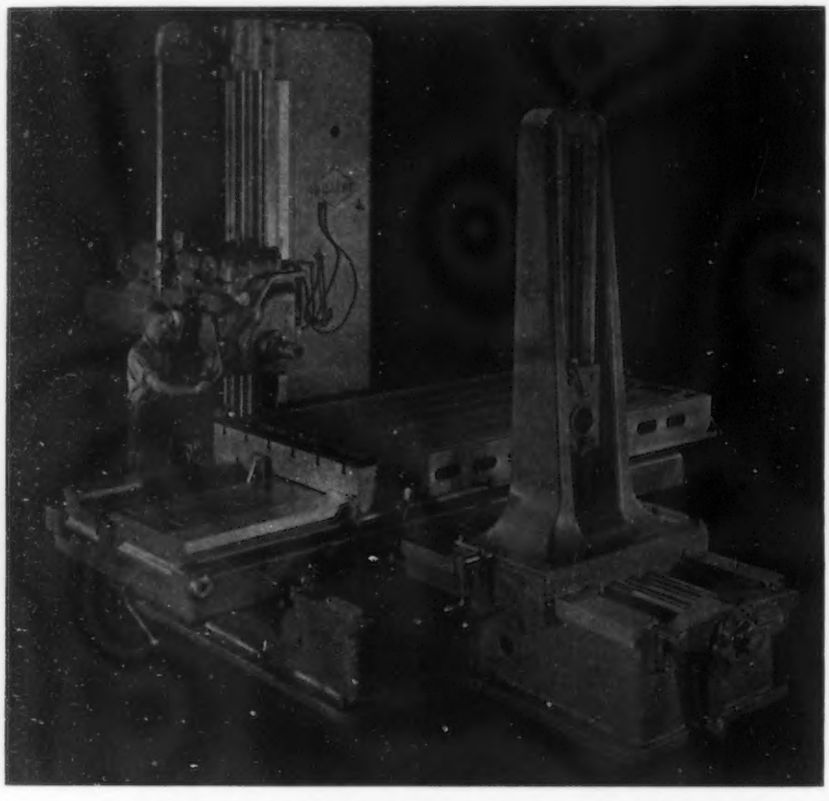
All it is possible on these pages to show but a few illustrations of the wide range of CINCINNATI Machines.

Complete information on CINCINNATI Milling, Broaching, Grinding, Lapping and Die Sinking Machines is yours for the asking.

THE CINCINNATI MILLING MACHINE CO.
CINCINNATI GRINDERS INCORPORATED
CINCINNATI, OHIO, U. S. A.

broaching involute splines on the inside of propeller shaft tubes. The broach is pulled through the tube, roughing and finishing the splines at one stroke. When the machine is started, the broach is raised by a cylinder in the base until it engages an automatic puller in the ram.

Colonial also brought out a continuously operating, alternating cycle dual-ram machine for broaching automotive connecting rods and caps at the rate of 400 an hr. The machine is a three-ton type with 18-in. stroke. Operation is automatic except for loading. While one ram moves down for the cut, the other moves up and the fixture ejects the work.



IN the unit-head Sellers horizontal boring, drilling and milling machines, the head contains the main driving motor, all speed and feed changes, and hand and power traverse to spindle, head, saddle and table. The directional controls, however, are at the base of the column and on the saddle.

Cut-off Machines

A new principal of abrasive cutting whereby the arc of contact remains constant regardless of thickness of stock is exemplified in the "Cutamatic" machine introduced by the *Andrew C. Campbell* division of the *American Chain & Cable Co.*, Bridgeport, Conn. A uniform arc of contact is maintained by a combination of oscillating and rotating increments of the hydraulically fed abrasive cutting wheel. Coolant is supplied both sides of the wheel to prevent warpage.

The *Bridgeport Safety Emery Wheel Co.*, Bridgeport, Conn., has taken its No. 48 "Abrasaw" cut-off machine and converted it into a wet type of cutter by providing coolant tank, pump and pipes for directing the fluid to both sides of the disc. Either foot pedal or hand operation is available. Depressing the foot pedal clamps the work, and starts the flow of coolant.

The *Cincinnati Electrical Tool Co.* also brought out a wet abrasive cut-off machine. The material is held in the vise by spring hinges on the side of the jaws and is released by operation of a foot lever, leaving the operator's hands free. The wheel spindle is mounted on ball bearings and is regularly driven through multiple V-belt.

Drilling Machines

Multi-speed induction motors have been applied to a line of motor-on-spindle drilling machines made by the *Edlund Machinery Co., Inc.*, Cortland, N. Y. By means of a knob switch, spindle speeds of 600, 900, 1200 and 1800 r.p.m. are available, and twice these with a back gear and high-speed motor. Semi-automatic power feed can be applied and is engaged when the drill touches the work.

Flexible shafts between driving motor and pulley and also for multi-spindle drives are found in an adjustable-spindle type drilling machine made by the *Automatic Machine Co.*, Bridgeport, Conn. The 12-spindle boxes are independently adjustable radially and spindle driving shafts are only 0.15 in. in diameter.

Toledo General Mfg. Co. added to its line two sizes of multiple-spindle, ball-bearing sensitive drilling machines with separate vertical motors driving through four-step cone pulleys. Regular speeds for the smaller machine, capacity ⅜ in., range from 1900 to 12,000 r.p.m., while those for the ⅝-in. capacity unit range from 685 to 3400. Both models can be furnished with power feed and any number of spindles up to six.

Delta Mfg. Co., Milwaukee, made a number of improvements in its 17-in. driller, which may be had in either floor or bench type. The column is made of 3½-in. tubing, ground and polished. The full-floating, five-step, cone pulley is mounted on sealed ball bearings as is the spindle. Capacity is ¾ in. in cast iron.

A high-speed precision sensitive drilling machine suitable for drilling holes down to 0.002 in. in diam. was brought out by the *Taylor Mfg. Corp.*, Milwaukee. Spindle speeds range from 2000 to 40,000 r.p.m. The counterbalanced spindle quill is said to be sensitive enough to give the "feel" of even the smallest drill.

Flexible Shaft Equipment

V-belt drive and cone pulleys give the Assembly P flexible shaft machine, made by the *Stow Mfg. Co.*, Binghamton, N. Y., three operating speeds of 900, 1725 or 3400 r.p.m. Designed as a bench type machine, regular equipment includes a ball bearing hand-piece. It is made in seven models from ⅛ to 1 hp. in capacity.

N. A. Strand & Co., Chicago, developed a ¼-hp. flexible shaft machine especially for the use of tool and die makers. Two combinations of speeds are available through the three-speed ball bearing countershaft, ranging as high as 10,400 r.p.m.

In a much heavier line made by the *Charles L. Jarvis Co.*, Middletown, Conn., from 12 to 14 speed changes can be made instantly through a so-called Vario-Flex drive to the counter-

RED RING
SHAVED GEARS ARE ALWAYS
UNIFORM

Gear tooth shaving is basically the reduction of rough cut gears to a common denominator.

Red Ring shaving corrects not only the dimensional errors in gear tooth profile, but it removes surface roughness and washboard effect.

Notwithstanding the advantages in gear uniformity and the quietness of gear operation thus attained, rotary shaving is less expensive than other methods of finishing. It is a regular production operation requiring only from 20 to 40 seconds per unit processed.

"Modern Methods of Gear Manufacture", a comprehensive treatment of this subject is available to production and engineering executives.

Patents applied for and issued: 1989650; 1989651; 1989652

Write for descriptive literature

NATIONAL BROACH & MACHINE COMPANY
Shoemaker & St. Jean
Detroit, Michigan

The Stage is Set

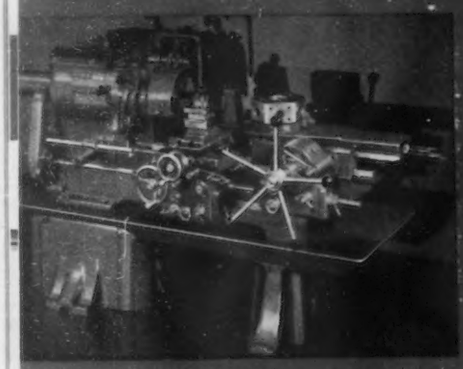
TO CUT YOUR COSTS IN 1938

New Gisholts have set the stage . . . giving you a sure way to make more money in 1938. Each one, regardless of size, offers new refinements that assure quicker setup, faster cutting, simpler operation and greater precision. These advantages enable the new Gisholts to save an average of over 35% of machining costs wherever they replace older machines.

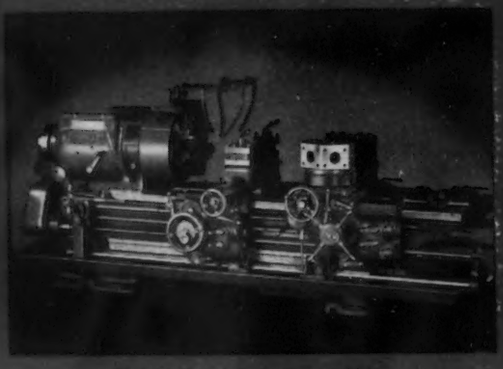
Keen executives are capitalizing on these high-speed Gisholts to increase output and cut costs, not only for this year, but for years to come.

It will pay you to recheck your present methods and equipment, **now**. Ask the nearest Gisholt engineer to call. Or write us for the latest information on Gisholt Turret Lathes and Balancing Machines.

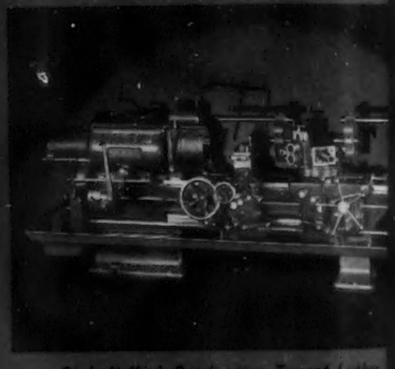
GISHOLT MACHINE TOOL



Gisholt Universal Ram Type Turret Lathes
3–1⅛"x10" bar cap., 8" or 10" chuck, 15⅛" swing
4–2"x12" bar cap., 8" or 10" chuck, 18⅛" swing
5–2⅛"x14" bar cap., 10" or 12" chuck, 19¼" swing



Gisholt Heavy Duty Turret Lathes
3AL—6¼" or 7⅛" spindle bore,
21" chuck, 27" swing



Gisholt High Production Turret Lathes
1L—2⅛"x36" bar cap., 12" chuck, 19" swing
2L—3⅛"x48" bar cap., 15" chuck, 22⅜" swing
3L—4⅛"x48" bar cap., 18" chuck, 26⅜" swing

Gisholt Heavy Duty Turret Lathes
9¼", 10⅝" or 12¼" spindle bore, 24" chuck, 28" swing
9¼", 10⅝" or 12¼" spindle bore, 28" or 32" chuck,
34⅛" swing

Gisholt Balancers and Tool Grinders.
Static Balancers—4 sizes
Dynamic Balancers—5 sizes
Tool Grinders—for single point tools

Gisholt Simplimatics—
Platen type—18" or 24" chuck
Radial type—18" or 24" chuck

GISHOLT

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shaft of the flexible shaft equipment. The motor carries a spring-backed, split V-belt sheave and the countershaft is carried in a large eccentric bushing, with notched sector for adjustment. The V-belt finds its proper pitch diameter on the driving sheave to accommodate itself to varying center distances. The machine is made in three sizes of 1, 1½ and 2 hp.

Gear Cutting Equipment

Farrel-Birmingham Co., Buffalo, brought out a new model of Sykes gear generating machine suitable for cutting double helical continuous tooth gears with sharp apices, single helical gears, straight spur gears and internal gears with straight or helical teeth. In addition, it can cut two members of a cluster gear simultaneously, or cut a large number of gears in a gang by means of numerous cutters working simultaneously, beside cutting spline shafts and some forms of cams. Like all other Sykes generators, it operates on the gear shaper principle, using circular gear-form cutters. Its capacity ranges from gears ¼ to 25 in. in diam. and up to 8 in. in face.

Another development of Farrel-Birmingham and one made with the cooperation of the *Air Reduction Sales Co.*, New York, is a machine for the selective surface hardening of double or single helical gear teeth by the oxy-acetylene flame and water quench method. The Airco tips have both heating and quenching holes immediately following, with gas and water connections.

For herringbone gears, there are two separate torch heads each carrying two sets of tips so that both sides of a tooth are hardened simultaneously. Seven sizes of tips are available to cover teeth from 6 to 1 d.p. The machine will harden single helical or straight spur gears up to 84 in. diam. by 24 in. face, as well as splines or rolling mill wabblers, sprocket gears and the like.

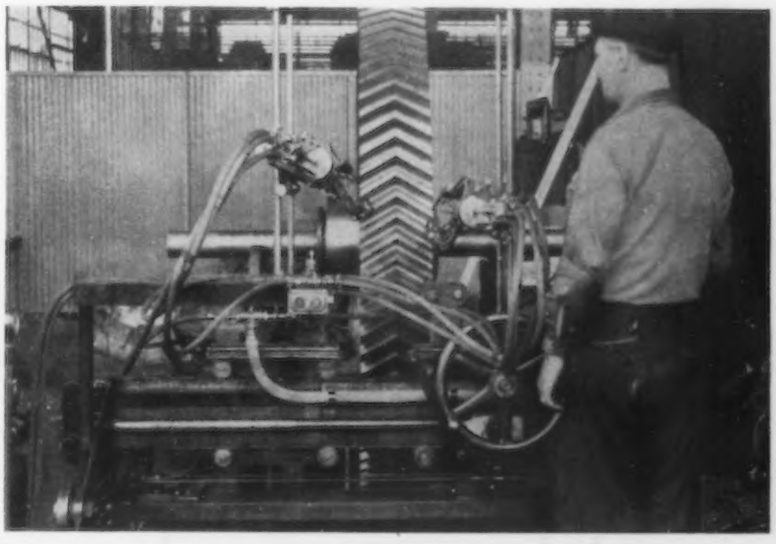
Classed among gear cutters is a rack cutter brought by the *Fellows Gear Shaper Co.*, Springfield, Vt. It cuts straight or helical tooth racks up to 48 or 60 in. in length. A circular shape cutter is employed and the saddle carrying the spindle is of the relieving type, mounted on trunions. At the completion of the roughing cut, the cycle can be set to complete the finishing cut, or work may be completed in one pass. Push buttons and selector switches give complete electrical control.

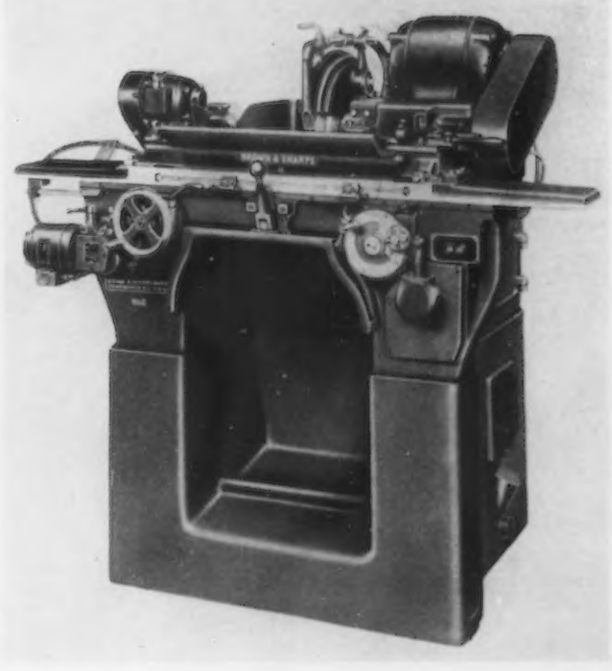
Earlier in the year, *Fellows* announced a new method of shaping fine-pitch gears, 16 d.p. and finer. A gap type cutter is employed with separate sectors of roughing teeth and finishing teeth. With this method, the teeth on the gear blank are cut to full depth in the roughing operation, and the finishing cutter teeth take only a light cut from the sides of the gear teeth, thus conserving cutter life. The cutter makes only part of a revolution and is stopped in the gap. Two-gap cutters may be had, finishing two pinions at a time, and there may be two stages of roughing teeth.

A fully automatic hobbing machine was introduced by the *Barber-Colman Co.*, Rockford, for cutting small gears and pinions up to 1 in. in diameter and ½ in. face and up to 24 d.p. in brass or 32 d.p. in steel. Work blanks are fed automatically from a magazine.

Gear Finishing Machines

Gear finishing by the shaving process is receiving wider acceptance and more universal types are being offered for short production runs of wide variety. The *Michigan Tool Co.*, Detroit, for example, has supplemented its high-production line of rack-type gear finishers with a two-cutter,



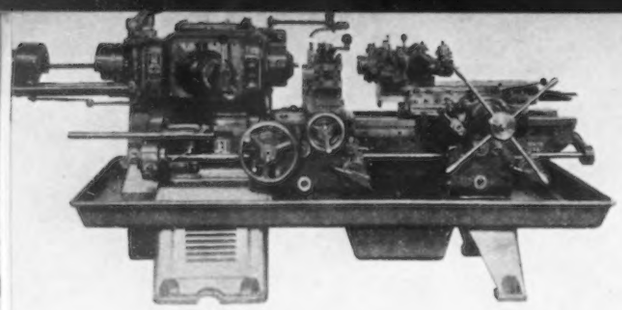


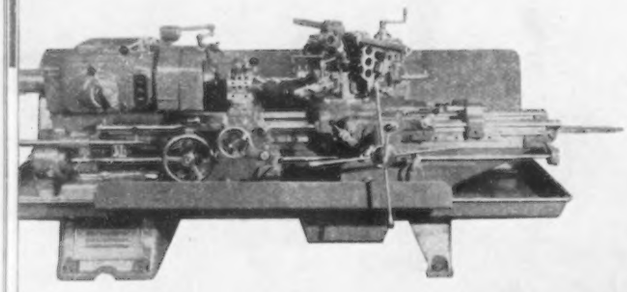
ABOVE

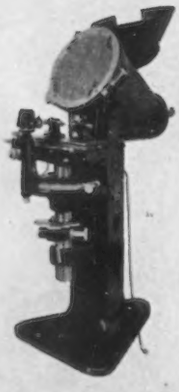
SELECTIVE flame hardening of helical, herringbone or straight teeth can be done on both sides of teeth simultaneously on this Farrel-Birmingham machine using Airco tips with gas and quench water jets.

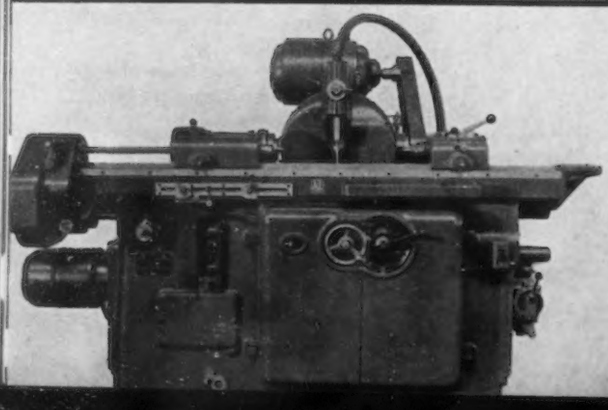
AT RIGHT

A "SIT - DOWN" in the grinding department. Brown & Sharpe's small, production type cylindrical grinder provides leg room for the operator to sit at work, with controls conveniently located within easy reach.









THE J&L LINE OF M

RAM TYPE TURRET LATHES 8

SADDLE TYPE TURRET LATHES 12

AUTOMATIC DIE HEADS 20

COMPARATORS 24

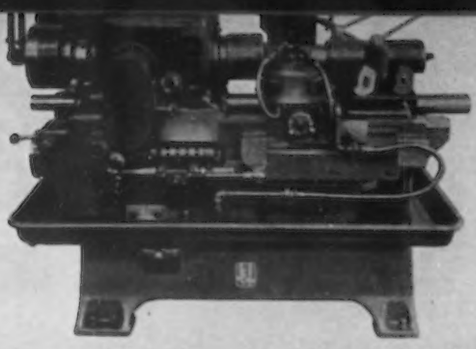
AUTOMATIC THREAD GRINDERS DOU

JONES & LAMS(N

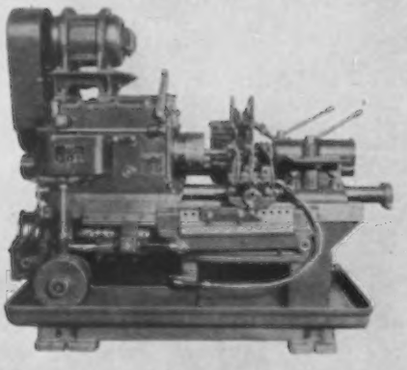
SPRINGFIELD · V M

MACHINE TOOLS

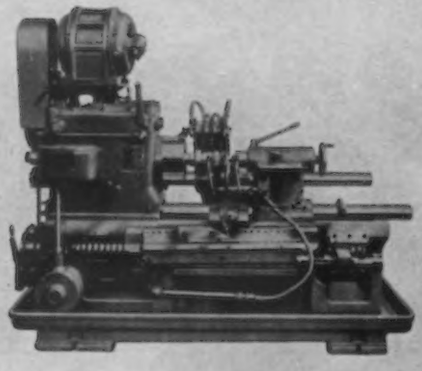
8 INCH FAY AUTOMATIC LATHES



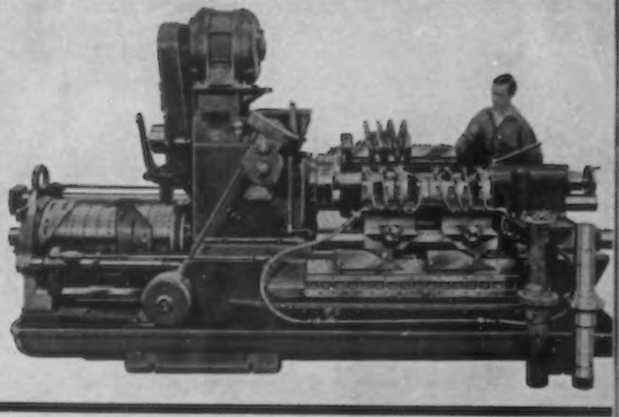
12 INCH FAY AUTOMATIC LATHES



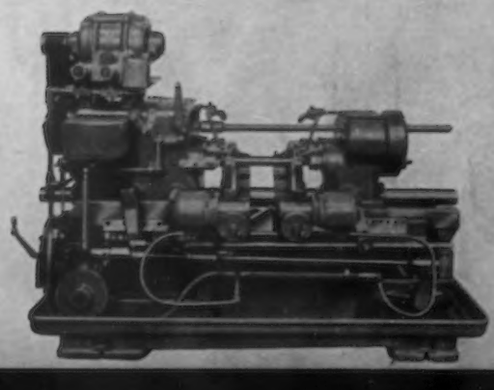
20 INCH FAY AUTOMATIC LATHES



24 INCH FAY AUTOMATIC LATHES



DOUBLE END MILLING & CENTERING



N MACHINE CO.
MONT · U·S·A·

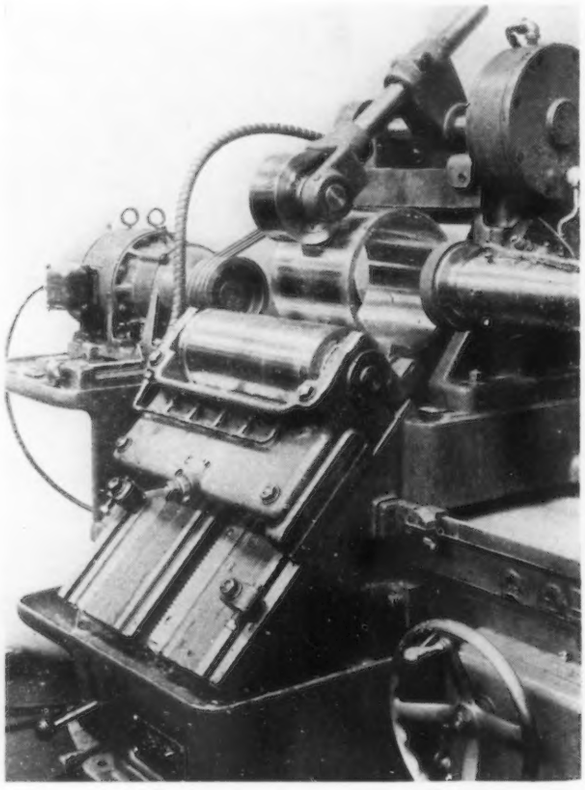
crossed-axis rotary machine. In this duplex finisher, the gears are passed in mesh between two crossed-axis, serrated-tooth cutters. As in the rack-type machine, the crossed-axis rotary cutters create a sliding action lengthwise of the teeth. Two cutters can be used independently to finish simultaneously two gears of different characteristics in a cluster, or both right and left-hand sides of a herringbone gear.

Fellows Gear Shaper Co., Springfield, Vt., also introduced a machine for finishing gears by the enveloping generating process with axes of tool and work askew. In this set-up, several forms of cutters may be used and the tool is rotated at high speed, while being traversed at low speed. Unless restricted, the tool is traversed slightly more than the width of gear face; otherwise the work is fed steadily up into the tool which is reciprocated only 1/32 in. Maximum capacity is 8 in. pitch diam., 2½ in. face and 4 d.p.

Gleason Works, Rochester, N. Y., has applied the so-called Formate method of finishing spiral bevel and hypoid gears previously rough cut. Extreme accuracy of tooth spacing is provided by taking a very light cut in a very rigidly constructed machine. A hardened and ground dividing plate is mounted directly on the work spindle, which is hydraulically clamped between indexings. The cutter spindle is mounted on preloaded anti-friction bearings. Cutter and gear remain in normal, full-depth position during the entire cycle, and the work is indexed for each cutter revolution by means of a gap in the cutter.

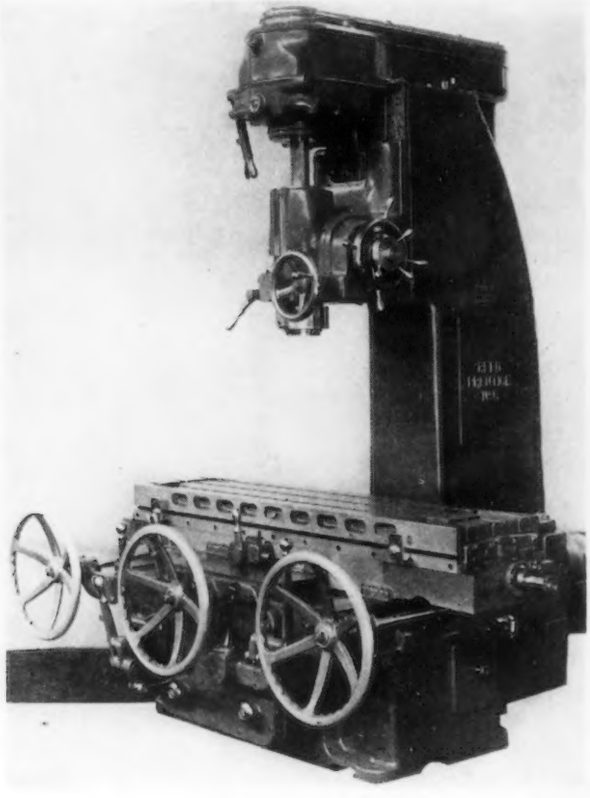
In gear tooth chamfering machines, the tendency is toward higher speeds. The *Cimatool Co.*, Dayton, Ohio, developed a line of machines with production rates as high at 600 teeth per min. in chamfering and burring operations. Air, hydraulic or manual operation is available. The smallest machine, the 4-A, comprises a single work head and a single cutter spindle. The 4-B has an additional cutter spindle for simultaneously finishing or machining similar teeth on the same face, but on opposite sides of the gear. The 4-C comprises two 4-A machines on a single base. The workhead indexes the gear and feeds it to the hollow mill cutters.

Cross Gear & Machine Co., Detroit, also brought out fully automatic lines of gear tooth rounding, pointing, chamfering and burring machines. There is a two-spindle burring machine, No. 70, with foot-operated pneumatic work-holding clamps. There is also a single-spindle model, No. 71. Similarly, on the gear pointing machines, a foot pedal controls the work-holding clamp. Both the single spindle, No. 40, and the double spindle, No. 41, will take gears up to 2 d.p. or finer and up to 10 in. face width and 20 in. diam. A simple change in set-ups adapts these machines for drilling, profiling or gear tooth burnishing.



IN this large size, No. 74 Heald Centerless internal grinder, both the support roll (front) and the V-belt driven work drive roll (rear) are carried on adjustable slides. Top pressure roll is attached to a shaft to which torque is applied by a hydraulic motor (right). Work up to 24 in. i.d. can be ground.

A TOP gear box equipped with helical gears mounted on Timken bearings replaces a belt drive on the No. 5 vertical miller and die sinker made by the Reed-Prentice Corp. It typifies refinement trends in 1937.



Gear Lapping Machines

National Broach & Machine Co., Detroit, simplified the structure and set-up arrangement in its latest model

PERFORMANCE PROVED!

SUNOCO STARTS ANOTHER YEAR AS A LEADER AMONG CUTTING LUBRICANTS

YEAR after year industry has recognized SUNOCO Emulsifying Cutting Oil as a leader in the field of cutting lubricants.

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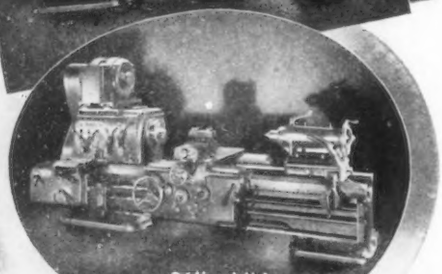
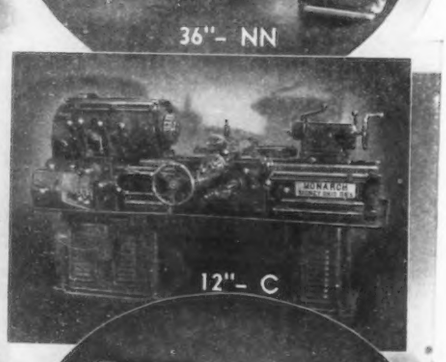
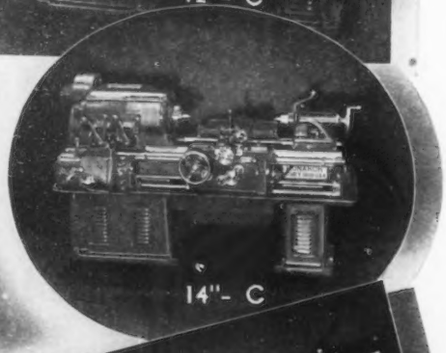
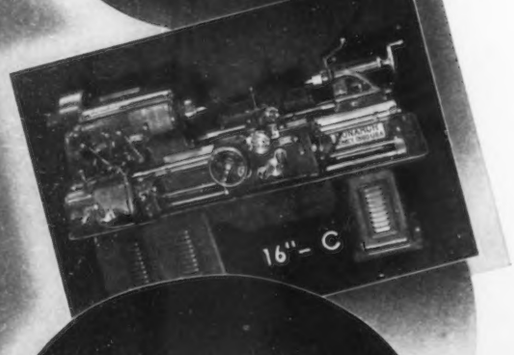
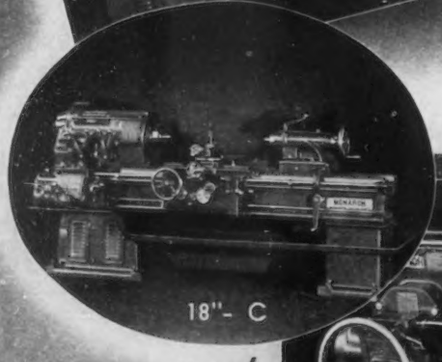
THE MONARCH LINE OF LATHES COVERS THE TURNING FIELD











THERE is no such phrase as "can't be done" in the Monarch dictionary. Never was this fact more apparent than in the vast array of improvements already completed for 1937 and '38. Two 40-page catalogs packed with new features, greatly improved production and testing facilities, and full coverage of all lathe sizes from 12″ to 36″—these and many other new factors point more definitely than ever before to Monarch as the key to lathe modernization plans.

OUTSTANDING FEATURES LIKE THESE CHARACTERIZE ALL MONARCH LATHES . . . .

With each passing year, Monarch engineers have created many new features and advantages, most of them exclusive with Monarch. They speeded up operation, reduced costs, simplified jobs, and met the increasingly high standards, constantly being set by industry today.

1. All steel parts including headstock spindle, tailstock spindle, all shafts, gears, clutches, and operating parts in headstock, end gear train, quick-change gear box, and apron, including bed rack *are made of nickel alloy steel, electric furnace hardened.*

2. All headstock gears have tooth contours ground on P. & W. gear grinders, to a tolerance of .0002″.

3. Headstock provides sixteen quickly secured mechanical spindle speed changes covering a wide range.

4. All headstock gears are helical, quiet, smooth, and powerful, and never transmit gear tooth marks.

5. Anti-friction bearings used thruout Monarch lathes to reduce friction, and prolong accuracy.

6. The hardened cam-lock spindle nose, the quickest known means for the rigid and accurate mounting of chucks, plates, and fixtures.

7. Alloy steel hardened and graduated oversize tailstock spindle.

8. Automatic force feed lubrication to bed ways, carriage, apron, compound rest.

9. Large diameter direct reading compound rest and cross feed dials.

10. Four distinct sizes of precision tool room lathes distinctly different in design from the engine lathe, and combining "built-in-lead-screw reversing mechanism," together with many features making them outstanding for precision tool room work.

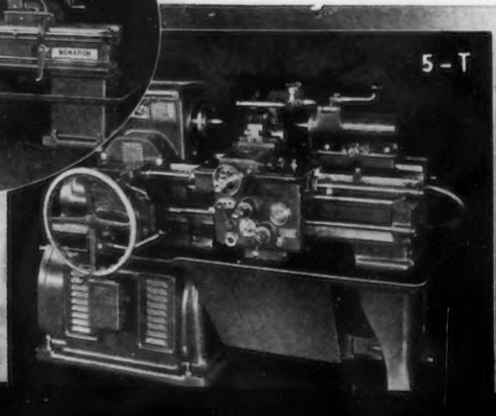
11. Special Alloy castings, many of which are made of Meehenaite, for all important units such as bed, carriage, compound rest, headstock, taper attachment, and many other parts.

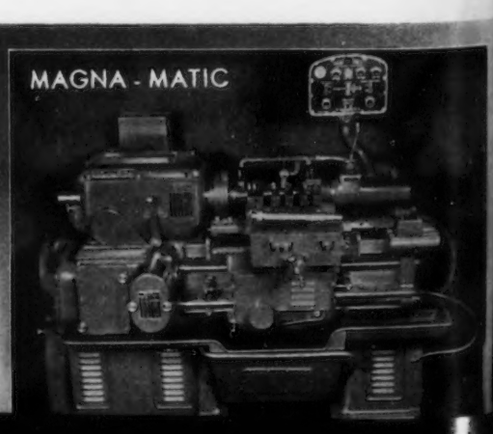
12. All handles, hand wheels, and operating levers are chromium plated to prevent rusting or tarnishing.

13. Convenient leveling screws, in all legs, provide the best and most convenient means of preserving and maintaining accurate installation.

. . . and many other outstanding design, material and construction features that reflect Monarch lathe leadership

Modernize with Monarch!





...nd here are some of the Monarch Lathes accessories

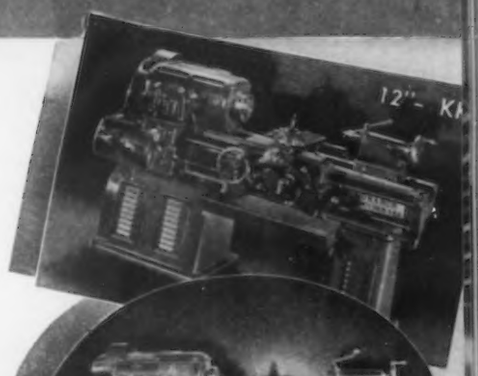
Production men and executives, concerned with lathe operation, have welcomed the presentation of each new Monarch accessory with enthusiasm, because experience has shown them that each of these new Monarch accessories has been specially designed to solve certain specific turning problems. Two-fisted production executives will recognize immediately the advantages made possible by the many new Monarch features, a few of which include:

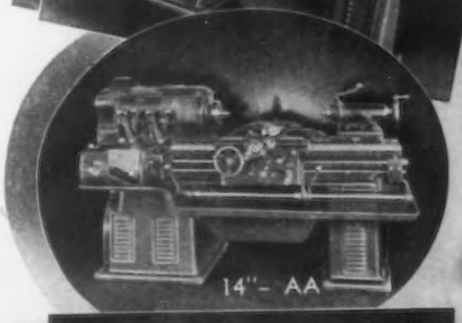
1. The anti-friction bearing taper attachment, which with the taper attachment variator, provides maximum tapers to 90 degree included angle, and length turning taper capacity at one setting the maximum length the lathe accepts between centers. Also provides facilities for contour turning and boring from a master template.
2. Micro-gauging dials of great assistance to the operator in accurate and quick diameter setting of tools.
3. Built-in anti-friction bearing tailstock centers for modern high speed turning.
4. Large capacity oil and chip pan.
5. Power angular feed tool slide, single and double, for angular turning and facing.
6. All types of tool rests to increase production and reduce cost.
7. All types of work supporting rests including the anti-friction bearing types.
8. All types of single and multiple length and diameter feed stops.
9. Keller electric controls, on all sizes of lathes, for all types of irregular contour turning and boring.
10. Cam milling attachments on the Keller controlled lathes for milling irregular contour shapes.
11. The Centrode Devices for turning and boring shapes other than round.
12. Oval Chucks for oval turning and boring.
13. All types of turrets for carriage and bed to broaden the scope of lathe work.
14. Relieving attachments as well as all accessories for precision tool room work.
15. The multi-speed drive for certain sizes of lathes. Any desired surface cutting speed, on all diameters, is automatically maintained.

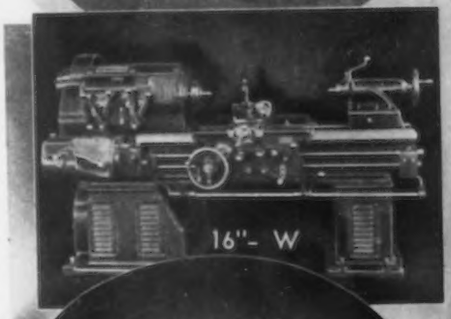
THE MONARCH MACHINE TOOL CO., Sidney, Ohio, U. S. A.

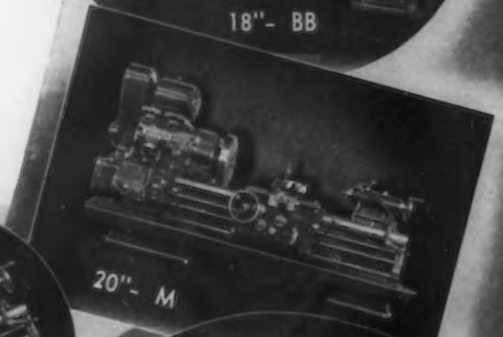
MONARCH LATHES
COVER THE TURNING FIELD
SIDNEY... OHIO, U.S.A.

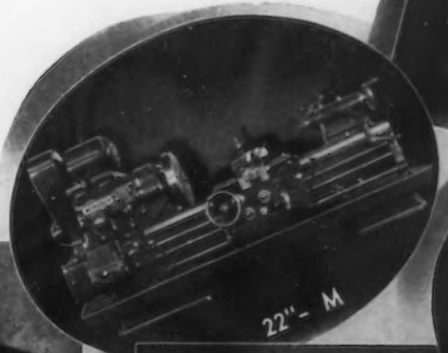
...tsburgh Sales Office: 604 Chamber of Commerce Building
...hicago Sales Office: 622 West Washington Boulevard
Indianapolis Sales Office: 3115 North Meridian Street
Newark Sales Office: 1060 Broad Street

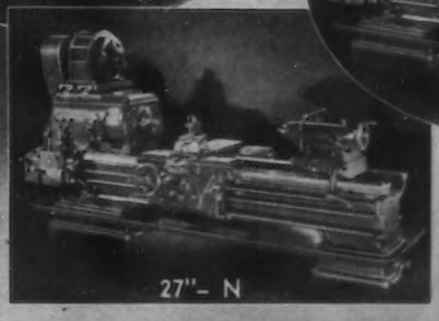


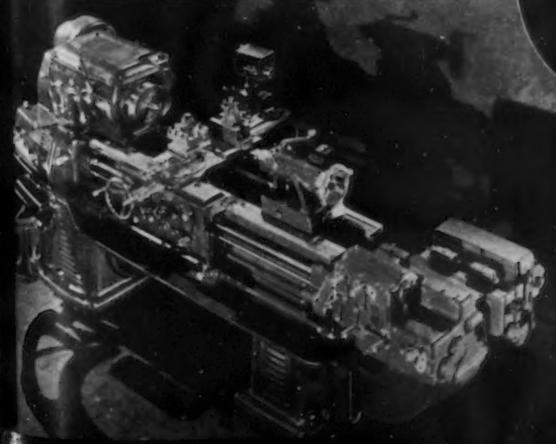










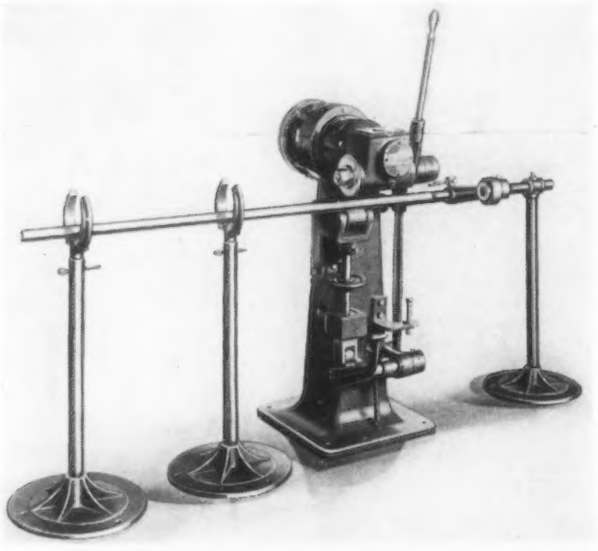


Modernize with Monarch!

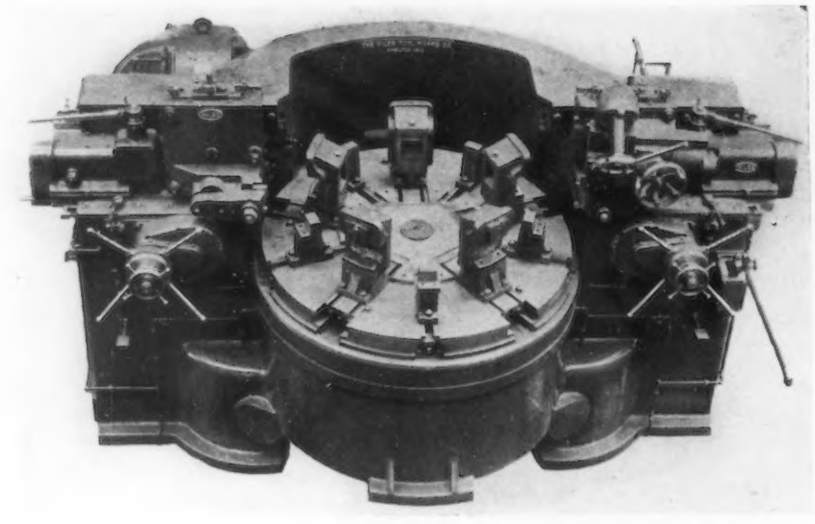
of "Red Ring" gear lapping machine, which utilizes the cross-axes principle of lapping and in which the lap gear drives the work gear which is loaded by means of a hydraulic brake. The lap is located below the work gear on a table which has a 15-deg. swing. The work spindle is carried on a reciprocating cross slide. This movement is actuated hydraulically and the length, speed and number of strokes are variable. The machine will accommodate gears up to 8 in. in diam. and 3¾ in. face.

Michigan Tool Co. brought out an automatic cycle gear lapping machine of the duplex type, also employing the crossed-axes principle, in which two laps may be used either for lapping front and back sides of gear teeth simultaneously or one side of separate gears as in a cluster. The laps are located on either side of the gear in a horizontal plane. The rear lap is driven while the work itself drives the hydraulically braked second lap. The gear spindle with its separate hydraulic brake mechanism is mounted on a reciprocating table. The machine will lap gears ranging from 1½ to 20 in. in diam. and clusters up to 30 in. in length.

A machine for burnishing small, fine-pitch gears up to 4 in. diam. and 20 d.p., two at a time, was brought out by *Fellows Gear Shaper Co.* There is one driven burnishing gear and four idlers with weights to provide the burnishing pressure. The work itself is held on slides for adjustment. Burnishing time is controlled by electric relays.



THE spindle of this Murchey high-speed pipe cutter is mounted on preloaded roller bearings and driven by hourglass worm from a flange-type motor.



THIS unconventional Niles locomotive tire turning machine is driven by a 75-hp. motor and carries both roughing and finishing heads with full-contour tools. The tire is located by an electrically driven centering chuck and clamped hydraulically.

An improved machine intended for burnishing larger size gears, from 1⅛ to 20 in. diam., has two idlers and one driven burnisher. Like the Fellows machine, the gears of the *Bolender* unit, made by *Cimatool Co.*, are mounted in a horizonal plane. The idler burnishers have screw adjustment on the slides for positioning and the master burnisher is mounted on a swing arm with V-belt drive. A dial gage shows the actual pressure between burnisher and work gears at all times. The burnishers are braked hydraulically.

Gear Checking Equipment

The application of the simple mathematical principle of the sine bar is incorporated in a series of gear checking machines brought out by the *Michigan Tool Co.* In the combined tooth form and spacing checker, front and back faces of a tooth may be checked simultaneously by the use of two indicators. Gears up to 12 in. diam. and 12 in. face may be read.

In the spiral lead checker, the sine bar is set to correspond with the spiral lead. The sine bar carriage and indicator are moved by handwheel and a clevis straddling the bar moves the upper carriage carrying the work spindle at right angles to the sine bar carriage. Capacity is for gears up to 16 in. diam. with leads of 6 in. or more.

The *Illinois Tool Works*, Chicago, supplemented its line of gear checking equipment with a worm and wheel checker which produces a chart of the running worm and worm wheel at the same time center distance, side height, lead angle, eccentricity and jump per tooth are being checked. Worm and worm wheel combinations with a minimum center distance of 5 in. or a maximum of 24 in. can be accommodated. The main bearing and cross slides of the machine are provided with ball bearings to insure ease in operation.

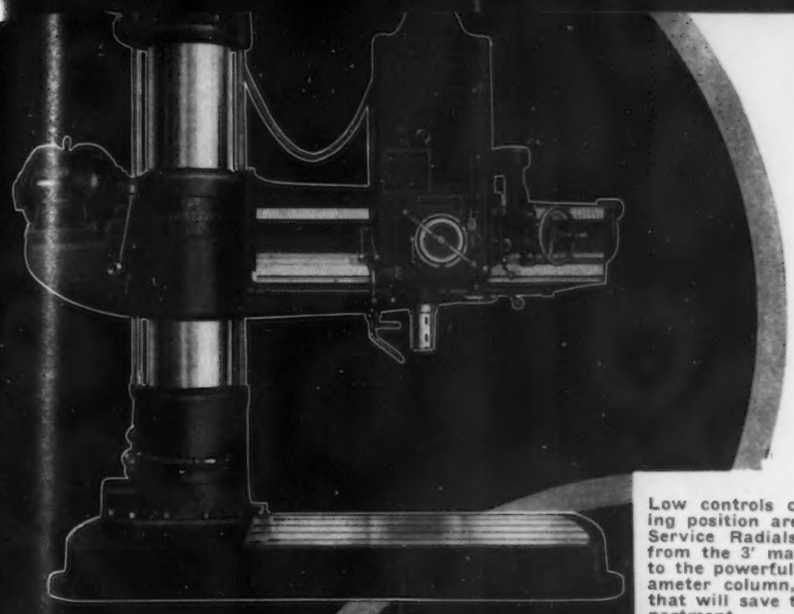
Grinding Machines—Cylindrical

Among improved grinding machines introduced last year is a plain cylindrical type of 14 and 16-in. capacity made by the *Cincinnati Milling Machine and Cincinnati Grinders, Inc.* Power is transmitted through V-belts from the variable-speed d.c. motor and thence through silent chain to the jackshaft. A rheostat adjustment gives 24 work speeds. The wheel-head spindle is mounted in preloaded radial bearings with a plain thrust bearing. The table is driven separately through

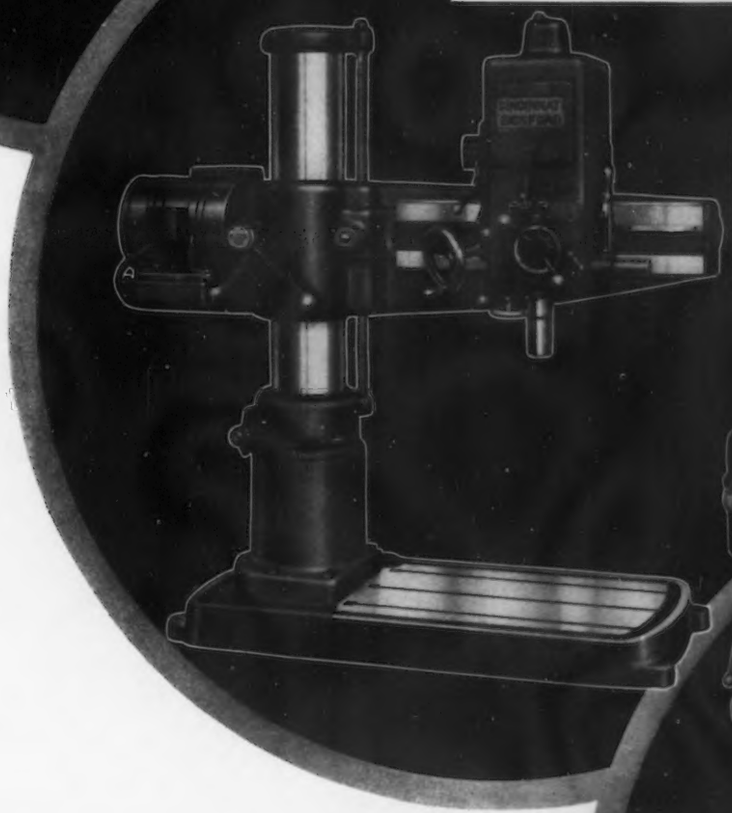
TIME SAVERS

for Your

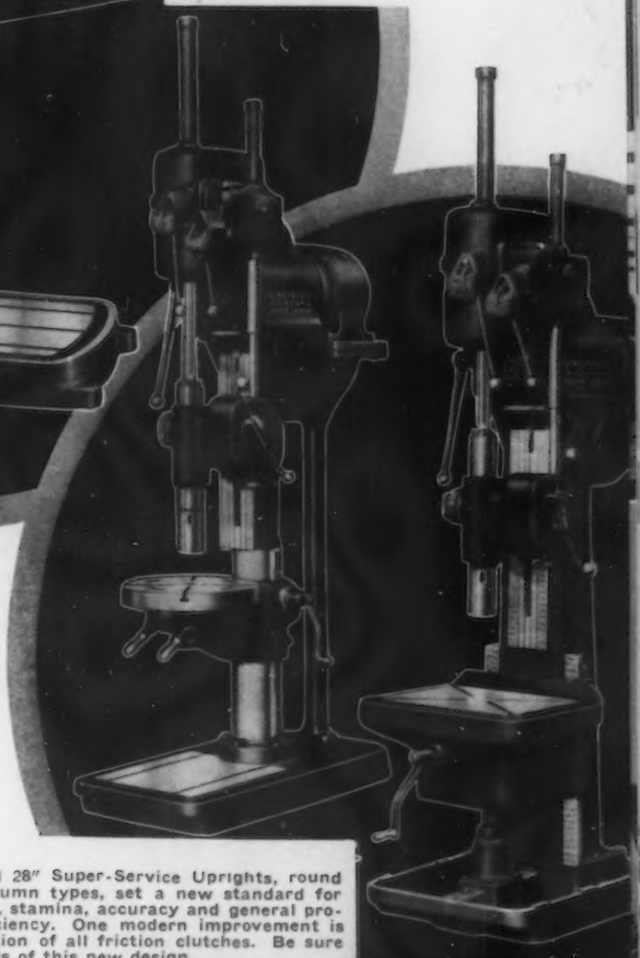
Drilling Departments



Low controls centralized 100% at the operating position are featured on the line of Super-Service Radials shown at the left. All sizes, from the 3' machine with 11" diameter column to the powerful 12' arm machine having 26" diameter column, incorporate new improvements that will save time and money in your drill department.



High Speed 3' and 4' Super-Service Radials wi provide a speed range to suit your work no mat ter how small your drilling. All speeds and feed changed by sliding gears with single lever con trol at the head. Balanced head and arm move o antifriction bearings for the ultimate in fast easy handling.

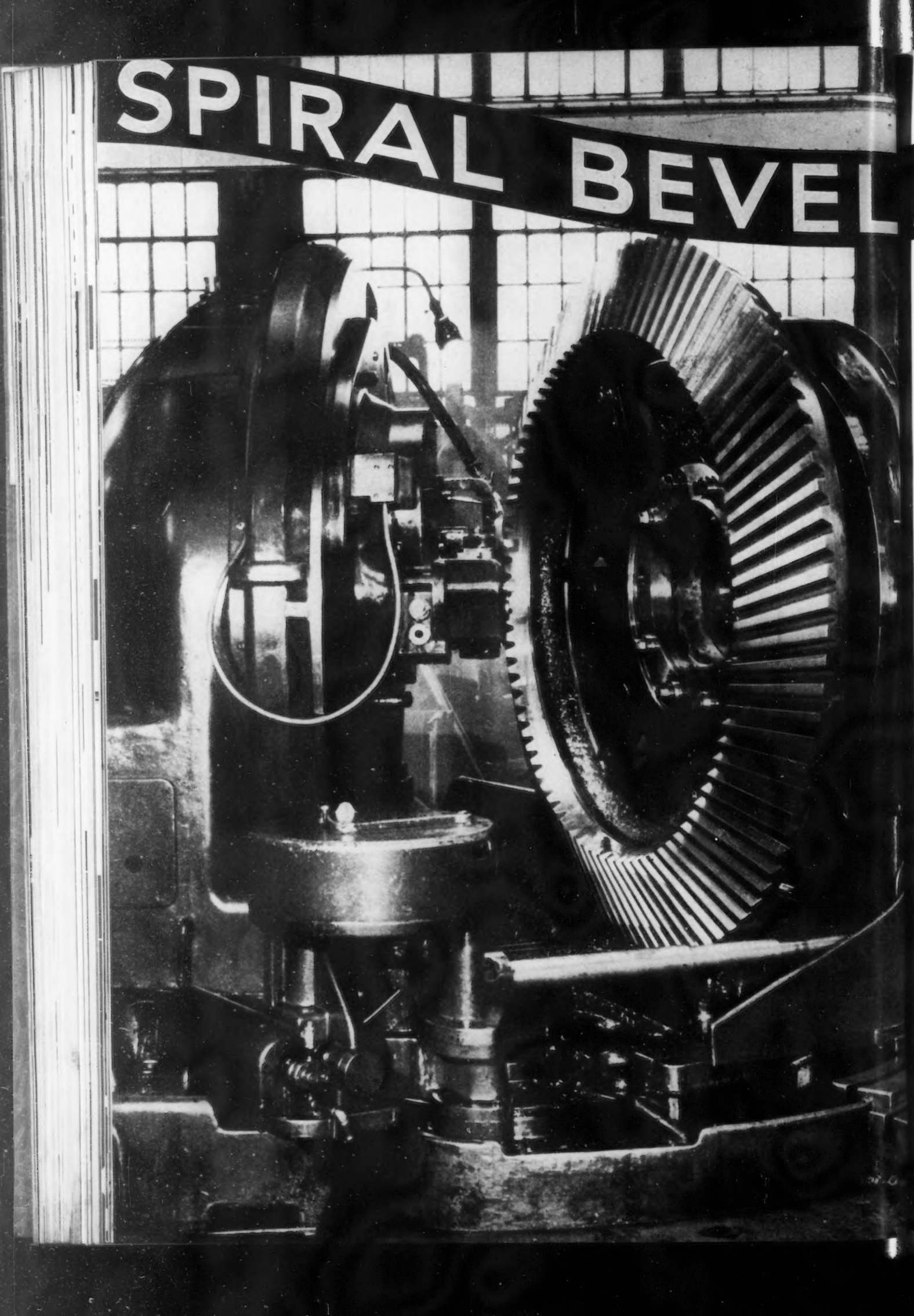


The most important machines in your shop include your radial and upright drills. New savings are possible with the recent Cincinnati Bickford developments. Features to give you "more holes per dollar" should be working for you now. Write for our latest catalogs.

21", 24" and 28" Super-Service Uprights, round and box column types, set a new standard for convenience, stamina, accuracy and general production efficiency. One modern improvement is the elimination of all friction clutches. Be sure to get details of this new design.

The Cincinnati Bickford Tool Company

Oakley, Cincinnati, Ohio, U. S. A.


SPIRAL BEVEL

AND HYPOID . . .

The Modern Gears for Big Drives!

•

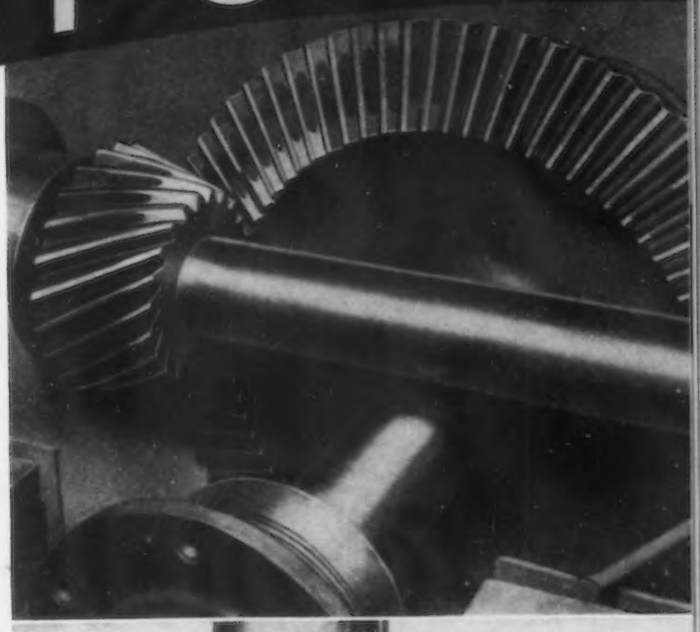
CURVED TOOTH

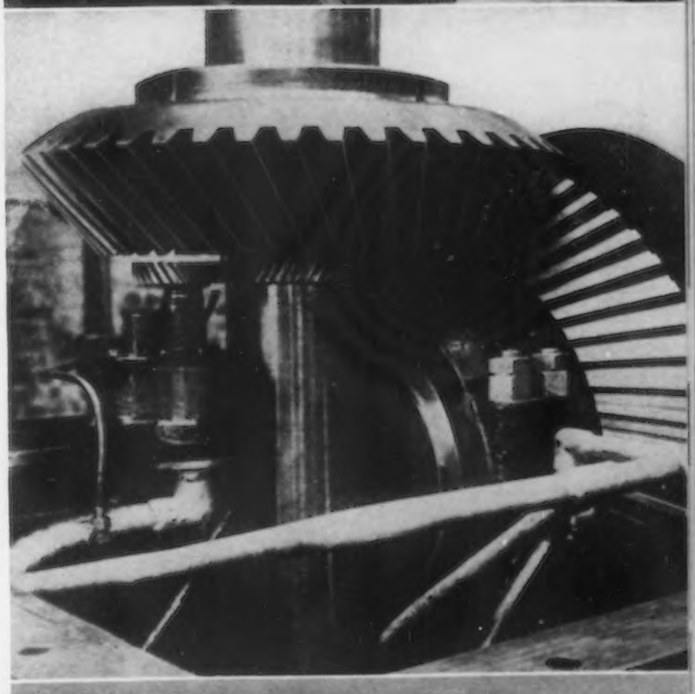
Spiral Bevel and Hypoid Gears are displacing the straight tooth bevel in all types of large drives where smoothness and quietness of action are required.

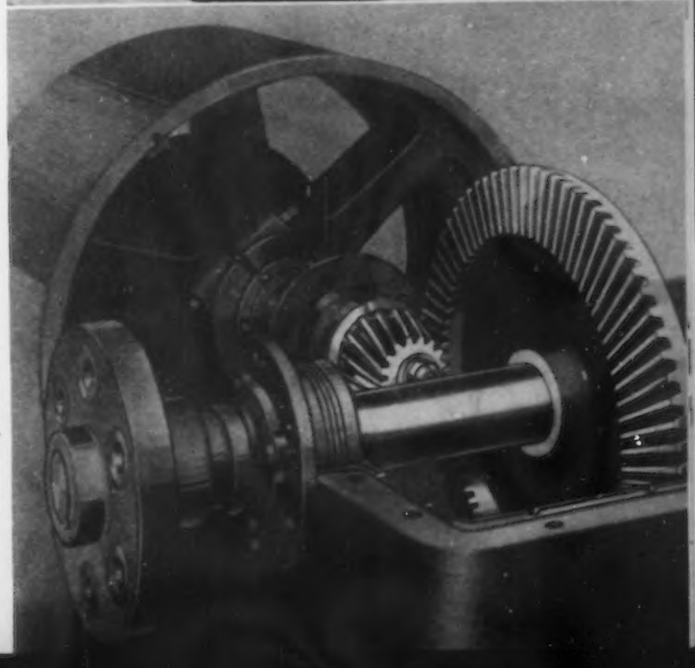
These spiral bevel and hypoid gears have curved teeth which give a continuous pitch line contact, overlapping tooth contact, and localized tooth bearing.

Hypoid gears besides having the same smooth action have the additional advantage of non-intersecting axes which permit the shafts to pass.

The teeth of these gears are *generated* on Gleason Spiral Bevel and Hypoid Planing Generators. One such Gleason generator is here shown cutting a 98″ spiral bevel gear for steel mill service. The steel industry now demands these gears for their extreme accuracy and high degree of efficiency.







GLEASON WORKS

Builders of Bevel Gear Machinery for Over Seventy Years

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a change gear unit. Between-center capacities vary from 18 to 168 in. for both sizes.

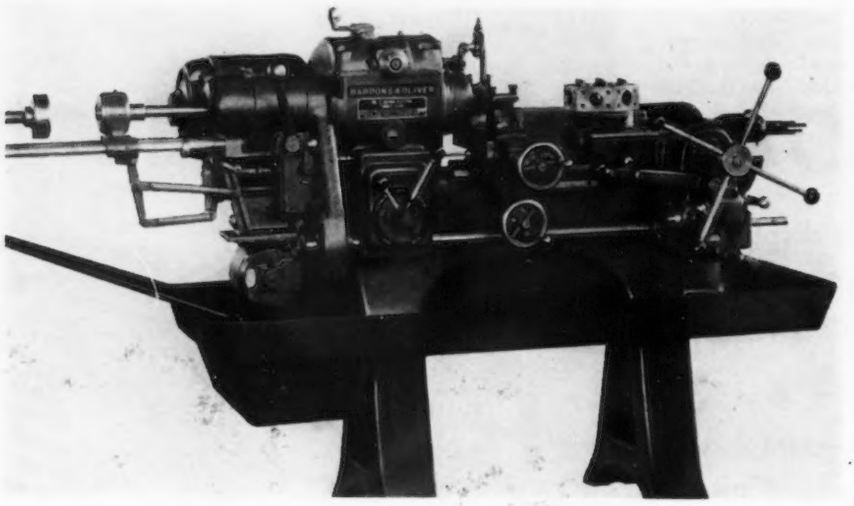
In the Type BD 10 and 14-in. plain hydraulic grinders made by the *Landis Tool Co.*, Waynesboro, Pa., which replace the Type B plain machines, the work and wheel spindles are driven through V-belts. The spindle bearings are babbitt lined and flood lubricated. Traverse speeds range from 12 to 240 in. per min. and are provided by a V-belt driven hydraulic pump. Both diameter ranges are available in sizes of 96 to 120-in. length.

A grinder of huge size was built by *Landis Tool Co.* for rough and finish grinding chilled iron rolls. The machine weighs 195,000 lb. and has 13 motors totalling 225 hp. Capacity is rolls 36 in. by 18 ft. The roughing wheel is made up of two 36 x 6-in. resenoid wheels mounted against each other and supported between bearings, the spindle drive being by V-belt from a 100-hp. motor provided with dynamic braking.

An extra-long rear bed section is provided to run either head out of the way while the other is cutting. One roughing wheel will rough out 17 to 18 as-cast rolls.

Another development is the 3 by 12-in. and 3 by 18-in. plain cylindrical grinding machine brought out by *Brown & Sharpe Mfg. Co.*, Providence. Maximum diameter recommended for efficient production grinding is about 1 in. All operating controls and adjustments are grouped at the front of the machine and the base is recessed to provide ample leg room for the operator to sit comfortably at work. Headstock and coolant pump motors are started and stopped by rotation of the cross feed handwheel for the grinding wheel. In combination with the headstock brake, this feature aids materially in maintaining high production.

Heald Machine Co., Worcester, Mass., brought out two new and larger sizes of its centerless internal grinder during the past year. The No. 73 covers internal bores of 4 to 8 in., and the No. 74, bores from 5 to 24 in. and 24 in. long. Both types are for producing bores concentric with the o.d. within precise limits on a high production basis. On the No. 74 size the centerless unit is carried on a massive bridge bolted to the end of the bed and carries three rolls—a support roll at the front, a V-belt driven work-drive roll at the rear and a pivoted pressure roll on top. Pressure is applied to this roll by a rotary hydraulic motor operating through a torque arm. The two lower ones revolve in waste filled troughs that wipe the rolls clean of grit. The grinding wheel is applied directly opposite the work drive roll to avoid distortion.



A FLANGE-MOUNTED, high torque, quick reversing, two-speed motor drives through splined shaft gearset on this Bardons & Oliver high speed turret lathe, which is also provided with an electric automatic chuck and bar feed. A motor-on-spindle model is also available.

A self-contained grinding wheel head designed to make automatic cycle grinders out of plain cylindrical machines was brought out by the *Fitchburg Grinding Machine Corp.*, Fitchburg, Mass. The "Bowgage" head has a bowed leaf spring toggle located under the head between it and the slide. By a hydraulic piston, the spring is flattened out and the elongation produced results in feed movement.

Wheel size may vary from 20 x 4 to 24 x 2 in., and the motor size from 3 to 10 hp. A lateral wheel spindle feed is also available.

The company itself has applied the design to an extremely compact cylindrical plunge-cut grinding machine. There is no table traverse, but there is wheel spindle reciprocation. With 14-in. max. swing over the table, and 12-in. max. length between centers, the floor space occupied is only 38 x 48 in.

Norton Co., Worcester, Mass., designed an entirely automatic arrangement of its 10-in. type C cylindrical grinding machine intended for plunge-cut operations. The automatic grinding cycle includes placing the work in the holding and driving position, grinding to size, releasing the finished piece and dropping it into a return chute. Cycle time is regulated by means of a hydraulic valve. Type of headstock, footstock and work-loading fixtures vary according to the shape and size of the work and the grinding requirements.

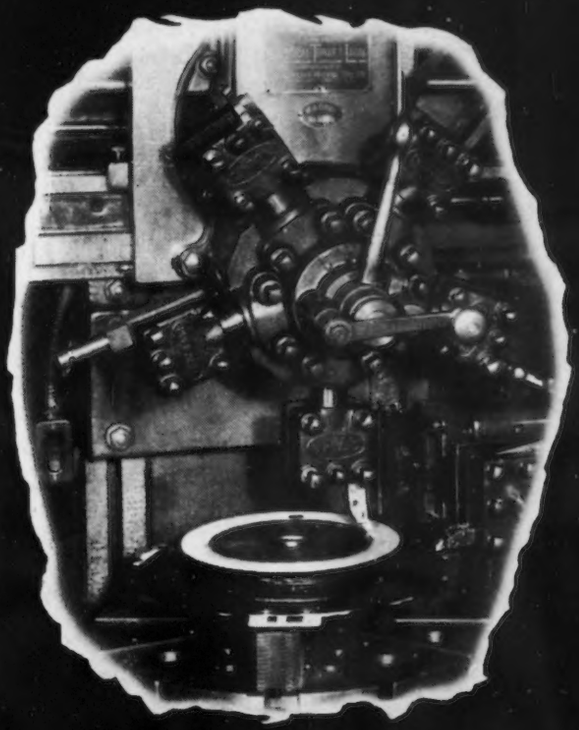
Landis Tool Co. brought out a Type C hydraulic grinder especially adapted for grinding automotive pistons slightly undersize across the pin holes. The work-holding heads are carried by a cradle and given a swinging motion by a cam on the same axis as the work and carried in large bearings so as to actually serve as the headstock spindle.

An attachment for making a precision grinding machine out of a lathe, especially for rolls where end space is limited, was introduced by the *Hisey-Wolf Machine Co.*, Cincinnati. It is a two-wheel grinder mounted on a dovetail slide with screw feed. A constant speed motor drives through belt to the ball bearing spindle. Six sizes are available, ranging from 1 to 10 hp. and with wheels of 8 to 20 in. in diam.

Surface Grinders

The *Hanchett Mfg. Co.*, Big Rapids, Mich., brought out its 400 series vertical spindle surface grinders in lengths of 50 to 132 in. and with a 22-in. diam. segmental wheel driven by either a 30 or 40-hp. motor. Table speeds up to 90 ft. per min. are available and the grinding wheel head is provided with hand, power or automatic feed.

Gallmeyer & Livingston Co., Grand Rapids, extended the range and added greater rigidity to its line of horizontal surface grinders. Both the base and the upright column that carries the vertical sliding head are heavy



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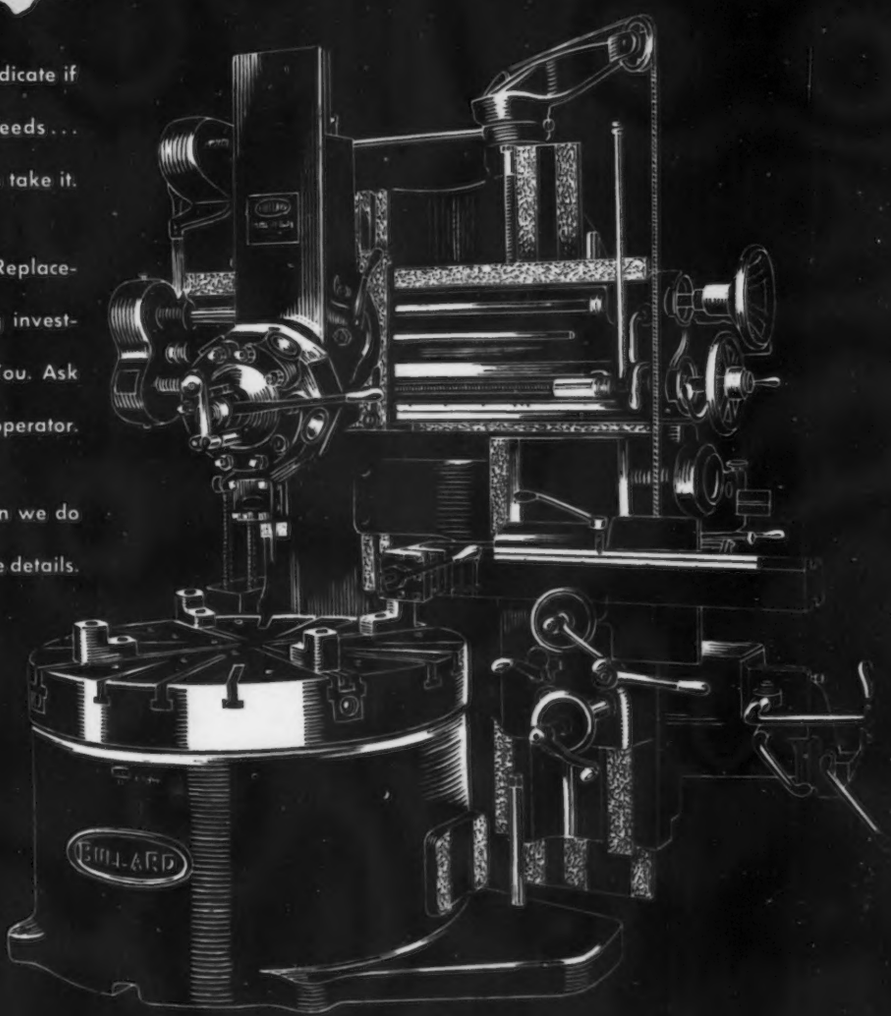
★ Ask us for Facts..."What can we do on your Work"... and machine details.



BRIDGEPORT **THE BULLARD COMPANY** CONNECTICUT

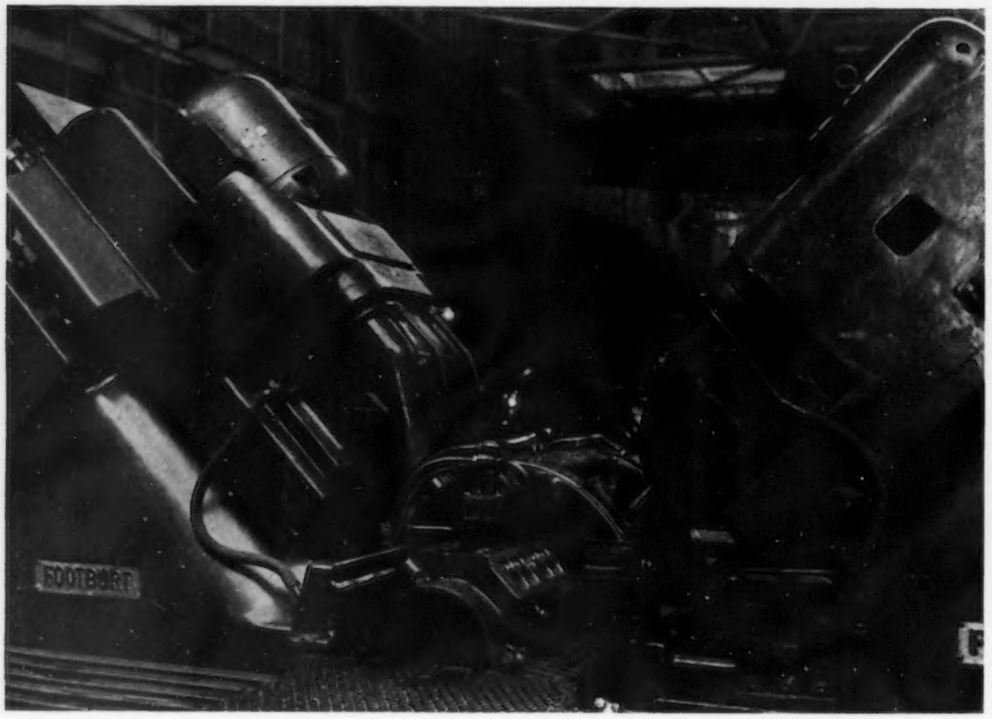
one-piece castings, generously ribbed. The base is twice the length of the working surface of the table. Table movement is hydraulically actuated, with speeds variable up to 150 ft. per min. A 25-hp. motor drives the wheel spindle through a splined shaft and does not accompany the spindle on its cross travel, which is 16 or 18 in. The spindle is mounted in ball bearings with an adjustable amount of preload. Capacity is 17 in. vertically.

ternal grinding, driven off the same motor by double shaft extensions. Work table can be swiveled and traverse is by handwheel or hydraulic power.

Covel Mfg. Co., Benton Harbor, Mich., offered a swivel head surface grinder designed primarily for grinding milling cutters, counterbores and special tools. The ball bearing wheel spindle with its 1½-hp. driving motor swivels 30 deg. in either direction and

ternal grinder made by the *Rivett Lathe & Grinder, Inc.*, Brighton, Boston, primarily for medium and large toolroom work. The cross slide upon which the wheel spindle and motor is mounted may be swiveled 90 deg. either side of center, the base of the work head may be similarly adjusted, and in addition the traversing table top itself has a total swiveling range of 50 deg.

The mechanical table motion is ar-



o o o

TO assure accuracy on this Foot-Burt unit-head boring machine, both heads and ways are water cooled, the head slides are long and wide and the spindles supported adjacent to the T-C cutters.

o o o

Standard Electrical Tool Co., Cincinnati, brought out a line of vertical angle-plate grinders in sizes from 2 to 10 hp. The motor ordinarily runs at 3600 r.p.m. and carries a 6-in. cup wheel on the spindle. The machine can be applied to planers, boring mills and other machine tools for finishing dies and similar operations. Both vertical screw feed and cross feed are provided.

Universal Cutter Grinders

Norton Co. completely redesigned its universal grinding machine which is supplied in 14-in. swing and in lengths of 36, 48 and 72 in. Five motors are required to drive it. The universal headstock swivels through 360 deg. and the universal grinding wheel head also rests upon a swivel base, with compound slide. There are separate spindles for external or in-

the table swivels 45 deg. both directions. The centers swing work 12⅛ in. in diam. by 14½ in. long.

A motor-driven model of its No. 1 universal cutter and reamer grinder was brought out by the *Union Twist Drill Co.*, Athol, Mass. Using a cup form of wheel, the unit will grind on centers a cutter 12 in. in diam. or a reamer 24 in. long.

In the 12 x 28-in. universal and tool grinder made by the *Landis Tool Co.*, the wheelhead may be swiveled 90 deg. right or left, and the headstock may also be swiveled 90 deg. for face grinding. With it, surface, external and internal grinding may be carried on and special attachments provide for grinding hobs, gear cutters, face and end mills, circular form cutters, large saws and other tools.

Much the same range of adaptability is found in the No. 112 precision in-

ranged to retard slightly as the table approaches center and accelerate immediately the center point is passed, overcoming bell-mouths, it is stated. Hole diameter grinding capacity is ½ to 8 in.; swing over table 14 in.

Other Cutter Grinders

Sundstrand Machine Tool Co., Rockford, introduced a double-end grinder for cemented carbide tools. For rough grinding, there is a silicon carbide wheel and for finish grinding, a diamond faced wheel is used, the tool being guided by a slidable protractor on the tiltable table. A fixture is also provided for rough grinding top rake angles as well as for front and side clearance.

Landis Machine Co., Waynesboro, Pa., has replaced an outmoded line of chaser grinders with a new line of motor-on-spindle machines. A cup and

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CHICAGO-LATROBE TWIST DRILL WORKS

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THIS unquestionably is the No. 1 news of the year in the Tool Making Industry. Conveniently located right in the heart of the mid-western industrial area, this new plant boasts the finest, most modern equipment known. It offers fast, dependable service to distributors and users of Twist Drills—Reamers—Special Tools. It has installed the latest, scientifically perfected heat-treating equipment, automatically controlled. A complete testing and research laboratory functions under the direction of skilled technicians. All these things insure unerring precision and uniformity in manufacture and *the ultimate in quality.* The Chicago-Latrobe Twist Drill Works is a combination of the Chicago Twist Drill Works and the long established Latrobe Tool Works. For better tools, better service—more holes per grind—insist on Chicago-Latrobe *Double-Circle* Tools! *Send for our new catalog.*

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a straight grinding wheel is provided. Model 0 is for grinding the smaller sizes of chasers, while No. 1 machine is a heavier duty machine and will grind chasers up to 1⅞ in. wide. The No. 1½ grinder is an extra-heavy-duty machine for grinding the largest chasers under severe production conditions. A traversing table and provision for coolant are found on this size at the cup wheel end.

Two new surface-broach grinding machines were brought out by the *Thompson Grinder Co.*, Springfield, Ohio. The automatic type is operated hydraulically and locates tooth spacing automatically, while a manually operated machine locates broach teeth either to a predetermined spacing or from established teeth. Wheel head is provided with a longitudinal slide and swivel and table operation is in timed relation with the wheelhead stroke. Machines are made in three sizes for broaches up to 6 in. wide and 48, 60 and 72 in. in length.

A table-type W-form wheel truing device is a feature of an improved spline shaft grinder introduced by the *Fitchburg Grinding Machine Corp.* With the truing device, the unit will accommodate shafts up to 60 in. long between centers. By turning one handwheel, three diamonds trim the sides and bottom radius of the grinding wheel. An automatic hydraulic ratchet down feed provides automatic cycle control.

A small bench grinder, driven by a fractional-horsepower universal motor, has been offered by the *Oster Mfg. Co.*, Cleveland, for grinding threading dies and chasers of all kinds. A special fixture and wheel is required for each type of chaser.

A detachable lathe grinder was added to the line made by the *Dumore Co.*, Racine, Wis. On this No. 12 size, the largest built, power is transmitted by V-belts from a 1-hp. capacitor motor and a set of six sheaves provide spindle speeds corresponding to wheel sizes of 8 to 3 in. Five internal and one external spindle quill are available and with them holes up to 24 in. deep may be ground internally.

Floor-Type Grinders

Vari-pitch sheaves on motor and countershaft, the latter running in cartridge ball bearings, give a practically straight line increase in revolutions as the wheel diameter decreases through wear in a heavy-duty floor grinder brought out by the *Safety Grinding Wheel & Machine Co.*, Springfield, Ohio. An interlock between the sheaves and the wheel guard shutters makes it impossible to run the wheels at excessive surface speeds for the larger diameters.

A somewhat similar type of wheel-wear compensator is featured on the Type AT heavy-duty floor type grinders introduced by *Kling Brothers Engineering Works*, Chicago. Seven V-belts are used in the main drive and the spindle is split for ease in replacing them.

The *James Clark, Jr., Electric Co.*, Louisville, Ky., extended the range of its floor type grinders by adding a 3- and a 5-hp. size. The motors are totally enclosed and the shafts are mounted on heavy-duty ball bearings. Safety devices include hoods adjustable for wheel wear and shatterproof glass shields. The wheel sizes are 14 x 2 and 18 x 3 in., respectively.

The *Cincinnati Electrical Tool Co.*

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Swaging Machines
The higher stresses created in swaging large tubes and bars are now controlled and absorbed by the heavy-duty construction of these new Etna Swaging Machines. Capacities are 2", 3" and 4" diameter tubing. Special and standard feeding devices are available. Write for bulletin.
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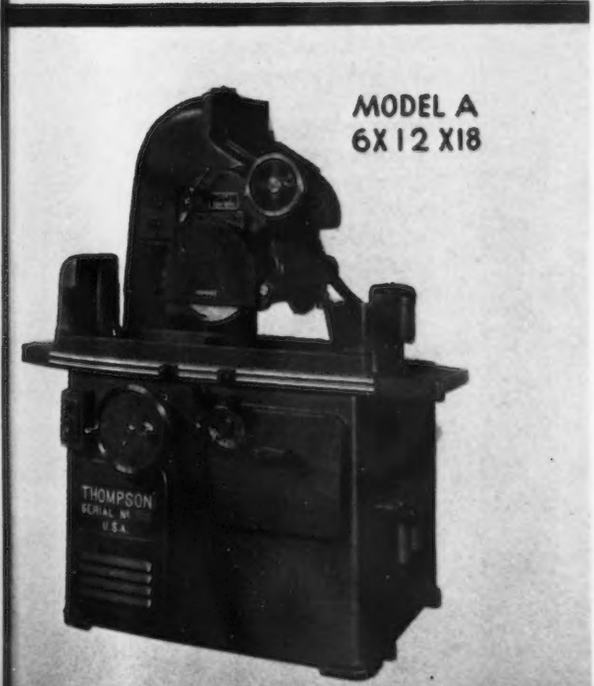

Hydraulic Grinders for Today's Needs!

And the needs of today call for accurate flat surfaces obtained with a minimum expenditure of time and effort. These requirements are fully met by Thompson Hydraulic Grinders.

Smooth hydraulic power permits a high table feed of 100 ft. per min. This, with the proper wheel, produces a finish not previously obtainable on a production basis.

Automatic wheel truing and vibrationless motor drive are two more of many features you ought to investigate. Made in several sizes and types. Get the whole story by writing us for a booklet.

THE THOMPSON GRINDER COMPANY
Springfield, Ohio, U.S.A.

THOMPSON

division of the *R. K. LeBlond Machine Tool Co.* brought out a line of floor-type grinders available with disc grinders at either end or with a disc on one side and a conventional grinding wheel at the other. A table with hand lever feed is regularly supplied on the right-hand end and a plain table at the other.

Hammond Machinery Builders, Inc., Kalamazoo, Mich., have also added two models of double-disc, floor-type grinders. The motor drives through multiple V-belts. Either a 5 or 7½-hp. motor is supplied for disks 18 or 20 in. in diameter. The spindle is on Timken bearings.

Standard Electrical Tool Co., Cincinnati, developed a line of lightweight, overhanging-column type floor grinders of 3, 5 and 7½ hp. capacity. Drive to spindle is by V-belt from motor in base. Grinding wheels from 12 to 18 in. can be used. The leaning column permits handling of bulky work with minimum interference.

The *Hisey-Wolf Machine Co.*, Cincinnati, brought out a two-wheel floor type grinder in which a built-in circulating coolant system is featured. A separator removes all grit before the water is returned to a reservoir from which it is pumped to valves on each wheel guard. Wheels of 10, 12 and 14 in. diam. are furnished, with any type of motor.

increases production
from 3 to 5 times
DEFINITELY MINIMIZES SPOILAGE
in AUTOMATICALLY FEEDING
and SETTING CLINCH NUTS
this is the 24" throat Clinchor for setting clinch nuts in an automobile floor panel. Our new Bulletins BC-1 and C-2 will give you specifications of the standard machines.
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Bench Grinders

Several bench grinders also appeared in 1937. *Diehl Mfg. Co.*, Elizabethport, N. J., introduced a double-end 7-in. grinder driven by a ½-hp. motor at 3450 r.p.m. *Black & Decker Mfg. Co.*, Towson, Md., introduced a 6-in. bench grinder driven by a ¼-hp. ball bearing motor. Wheel guards and tool rests are provided both models.

Baldor Electric Co., St. Louis, developed a bench grinder primarily intended for sharpening carbide-tipped tools. It carries both a roughing and a finishing wheel, the latter either a silicon-carbide cup wheel or a diamond impregnated wheel. Motor is ½ hp.

Honing Machines

The most significant development of the past year in honing equipment was the introduction of a machine by the *Micromatic Hone Corp.*, Detroit, that will hone bores down to ¼ in. in diam. with a tolerance for roundness and straightness held to 0.000025 in. Maximum diameter is ⅞ in. The maximum length is 2¾ in. for the smaller diameters, up to 7½ in. for the larger diameters. The machine incorporates the wobble plate principle for the reciprocating motion while the spindle is being revolved. Foot pedal control is provided so that the operator's hands are free to hold the work. Hone bodies are available for every 1/32 in. increase in diameter and have bayonet lock for quick interchange.

Improvements introduced in the hydraulic honing machines made by the *Barnes Drill Co.*, Rockford, Ill., include a unitary control lever with which both rotation and reciprocation may be started simultaneously. A latch on the lever permits reciprocating the spindle without rotating or rotation without reciprocation. A tachometer is provided. The spindle carriage is air counterbalanced. A hydraulic transmission permits infinite

variations in spindle speed from 100 to 250 r.p.m.

The same company also built what is believed to be the largest honing machine in the world, with hones up to 30 in. diam. The machine is 31 ft. 4 in. high and has a vertical spindle stroke of 90 in. The aluminum head reciprocates on balls running on flat tracks and is counterbalanced by an air cylinder. For hones up to 21 in., a 30-hp. motor drives the spindle, which has eight speeds, while a 15-hp. motor drives the hydraulic pump.

The year 1937 saw the passing of the *Hutto Machine Co.*, operated in recent years as a division of the *Carborundum Co. Barnes Drill Co.* took over the honing machine end of the Hutto line, and the *Micromatic Hone Corp.* will continue to supply Hutto-type hones. Heretofore, all Barnes machines were equipped with Micromatic hones.

Lapping Machine

A further development of the paper abrasive strip principle to automotive crankshaft and camshaft bearings is exemplified in two machines introduced by the *Norton Co.* In the Crank-O-Lap, lapping of each pin and bearing is by shoes which hold the abrasive strip in place. Take-up spools for winding used abrasive strip are carried at the ends of the arms. In the Cam-O-Lap, constant unit pressure on the cam surfaces is assured by providing master cams for each lapping arm. Abrasive strips and supports are reciprocated rapidly in the direction of the camshaft axis while the camshaft itself is rotated and reciprocated with a slower motion.

Manufacturing and Engine Lathes

The tendency toward higher spindle speeds in lathes continues as the application of T-C tools becomes more widespread. Spindle speeds up to 5000 r.p.m., for example, may be obtained on the improved "Lo-Swing Imp" lathe built by the *Seneca Falls Machine Co.*, Seneca Falls, N. Y. The machine swings 4 in. over the cross-slide and is designed primarily for work requiring high speeds and close accuracy.

An extremely long bearing is obtained by a design that permits the carriage slide to pass under the headstock. The spindle, driven by V-belt or chain, is mounted in precision preloaded ball bearings. The optional tailstock may be arranged for lever or air operation.

A third slide on an overarm is now available as standard equipment on any of the new style Lo-Swing Imp lathes. This slide is actuated by a cam on the main camshaft and hence is synchronized with the other turning and facing slides.

Following the success of its model 10 automatic "Stub" lathe, *Sundstrand Machine Tool Co.*, Rockford, brought out a smaller machine, the No. 8, of equally high productive capacity and flexibility. Operating cycle is entirely automatic and can be arranged to repeat indefinitely when automatic work-handling devices are employed.

A choice of four spindle speed ranges and three bed lengths is available. Maximum swing over ways is 15¼ in. diameter and 9 in. over the front slide. Front carriage feed is

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MODERNIZATION
Solid rivets are cheaper than other types. You would prefer using them because of this and because you would then get a stronger joint. But, there was no efficient means of setting them.
Now you can use solid rivets. You can realize savings on rivet costs. Now you can get that stronger joint—with a modern efficient machine—The Rivitor. You'll do your riveting smoothly, you'll do it automatically and with precision—and you'll be doing it at rates up to 3200 rivets an hour.
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RIVITOR

10 in. Design features include hardened steel ways.

On a high-speed manufacturing lathe made by the *Porter-Cable Machine Co.*, Syracuse, N. Y., multiple V-belts drive the spindle direct from the motor. Through pulley changes, spindle speeds up to 3600 r.p.m. are available. The feed pick-off gears are driven by V-belt from the hollow spindle, mounted on preloaded ball bearings.

Motor drive has been applied to standard cone-head lathes made by the *South Bend Lathe Works*, South Bend, Ind., in sizes of 9 to 16-in. swing. Motor and countershaft are mounted on a swinging pedestal back of the lathe. V-belts connect the motor with the countershaft and a flat belt drives horizontally between the cone heads. There is an adjustable belt-tension brace and a quick-acting lever allows the motor frame to tilt forward for belt shift. Improvements in the line include a heat-treated spindle with ground journals running in phosphor-bronze bearings and a new double-wall apron with steel gears and a multiple-disc clutch.

A motor-in-base model is also available. In this design, the motor drives the countershaft by V-belt, with a cone pulley to the headstock and vertical flat belt.

The *Sheldon Machine Co.*, Chicago, has also motorized its 10-in. lathe. Motor is mounted in a cabinet leg and four speeds are provided by V-belts, with four additional speeds through back gears. The machine may be had in a bench type.

Following the introduction of its combination crankshaft turning and broaching lathe in 1936, *Wickes Brothers*, Saginaw, Mich., developed a more universal type of machine, model UH-8, for turning large diesel and tractor crankshafts. Hydraulic feed gives automatic work cycle. The 15-hp. motor drives through multiple V-belts and anti-friction bearings are used throughout.

Bench Lathes

Spindle speeds of 150 to 3000 r.p.m. are now available in the precision bench lathes made by *Hardinge Brothers, Inc.*, Elmira, N. Y., through the use of New Departure's Transitorq drive in connection with a two-speed a.c. motor. Spindle drive is by V-belt. These bench lathes are offered in five sizes from ½ to 1-in. collet capacity and from 7 to 9-in. swing. Precision preloaded ball bearings are used for the spindle.

A built-in variable-speed drive is also a feature of a bench lathe produced by the *Stark Tool Co.*, Waltham, Mass. A ball bearing, ½-hp. motor drives through a disc clutch and variable V-belt sheaves. Any speed between 156 and 2200 or between 300 and 3000 r.p.m. are available. The high-speed model has anti-friction bearings; the other, tapered bronze. Collet capacity is ¾ to 1 in. and swing 9 in.

Transitorq drive is also found in the No. EH3 precision bench lathe made by the *B. C. Ames Co.*, Waltham, Mass. Speeds from 200 to 2000 r.p.m. are obtainable. Motor is ½ hp. The headstock is detachable from the bed, which is 36 in. long. Preloaded ball bearings support the spindle. Swing over bed is 8⅜ in.; collet capacity 1 in.

Lathe Attachments

Two lathe attachments were brought out during the past year. The *R. K. LeBlond Machine Tool Co.*, Cincinnati, improved its fully universal relieving attachment to provide relief up to ¼ in. by the use of two cams. A constantly revolving driving cam imparts oscillating motion to a follower cam, which in turn imparts the reciprocating motions to the tool slide.

The *Monarch Machine Tool Co.*, Sidney, Ohio, brought out an extremely wide range taper attachment featuring oil-sealed anti-friction bearings mounted on eccentric studs, 20 in all. The unit will turn or bore tapers up to 94 deg. included angle and for the full length capacity of the lathe at one setting, or can turn or bore irregular contours from a master templet. To make this extended range possible, a so-called variator consisting of a combination of pick-off pinions and two racks is employed instead of the regular solid bed bracket. The attachment is made in three sizes to take care of lathes from 12 to 36-in. swing, inclusive.

Milling Machines

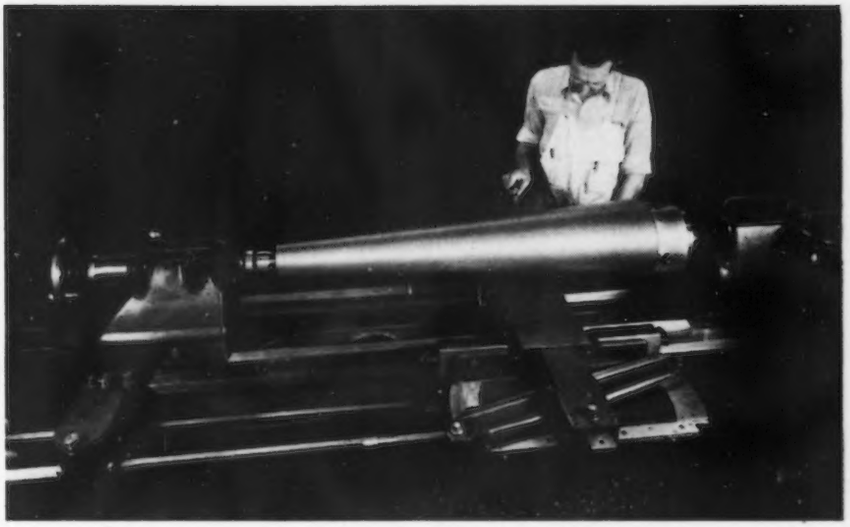
A small type production milling machine with complete electrical control of the table movement, known as the No. 2 Electromil, was brought out by the *Sundstrand Machine Tool Co.* A single lever provides manual control while setting-up, and the automatic

cycle is obtained by setting six types of dogs under a guard rail.

The vertical spindle motor in the base compartment drives the spline shaft directly. Vertical adjustment of the spindle head is by a ball-bearing-mounted handwheel with micrometer dial. Spindle runs in anti-friction bearings.

Reed-Prentice Corp., Worcester, Mass., brought out a universal milling machine especially adapted for general tool and die work. The self-contained motor driven head is capable of drilling and boring at any angle relative to the longitudinal feed and at any angle up to 60 deg. toward the back of the machine and 30 deg. toward the front, relative to the cross feed. Longitudinal feed is 16 in., cross feed 11 in. and vertical feed of the knee 15 in. Both rectangular and the circular table are available.

A light, simplified milling machine of the knee and column type, which the *Producto Machine Co.*, Bridgeport, Conn., added to its line, provides 12 spindle speeds and six table feeds by V-belts and pulleys. The machine accommodates a vertical milling head. It is especially intended for light manufacturing operations on small parts.



TURNING a taper 48 in. long with one setting of the attachment is possible with the Monarch anti-friction bearing taper attachment, incorporating the so-called variator with a fixed and a movable rack and pair of pick-off pinions.

Brown & Sharpe Mfg. Co., Providence, modernized its Nos. 2 and 3 sizes of plain and universal milling machines. Spindle speeds are 16 in number, ranging from 30 to 1200 r.p.m. A fast feed travel of 140 in. per min. longitudinally and 56 in. per min. transversely and vertically are provided. There are standard types and a dual-control type, front and rear. Thirty-two rates of feed are available on the latter, as against 16 on the standard model. Other improvements include a safety handwheel for longitudinal table adjustments, automatic lubrication of the knee and column, and rotating selective feed and speed levers.

A hand miller announced by *Miller & Crowningshield, Inc.*, of Greenfield, Mass., has V-belt motor drive to a jackshaft with four-step cone pulley driving the spindle. Both shafts are mounted on Timken bearings. 750 r.p.m. is top speed. Micrometer dial adjustment is provided for both the cross feed (3¼ in.) and the knee (9 in.). Longitudinal travel of the table is 14¼ in. Power feed can be furnished.

A huge milling machine with a cutter 68 in. in diameter was built by the *Ingersoll Milling Machine Co.*, Rockford, for scalping aluminum ingots at feed rates up to 6 ft. a min. A 150-hp. motor drives the spindle through multiple V-belts and the cutter travels at a speed of 3000 ft. per min. at the periphery. By using four wide tungsten carbide finishing blades in conjunction with 60 T-C roughing blades, rough and finish milling is performed simultaneously.

Rowbottom Machine Co., Waterbury, Conn., made a number of im-

Executives

CAN'T BE WRONG

The thousands of business firms who cut costs in the past year with new Warner & Swasey turret lathes and tools would read like a Blue Book of American Industry. The men who decided on these purchases probably totaled 10,000 of the keenest, most analytical and far-sighted executives in the country. They are men who invest only when it can be *proven* to them that the investment will result in lower costs, higher profits. That is exactly the kind of proof that can be demonstrated about the new, faster, more accurate, easier-to-operate Warner & Swasey Turret Lathes. May we demonstrate what these improved machines would do in your shop—and for your net profit?

WARNER & SWASEY Turret Lathes *Cleveland*

You can turn it better, faster, for less —with a Warner & Swasey.

provements in its combination cam milling and grinding machine, now designated as model No. 325. For grinding work, an auxiliary spindle is mounted above the cutter spindle and driven by the same motor. By means of a trunnion mounting, the work head can be operated on a horizontal axis for face cams or on a vertical axis for drum cams. Eight speeds are available for both work head and cutter spindle.

Vertical Miller

The cutter spindle and motor are mounted in an aluminum alloy head. Feed motor is interlocked electrically and reversals of both drives are effected electrically. Rapid traverse for the work head is by a separate motor.

Helical gear drive to the spindle is one of the improvements to the model 5 vertical miller and die-sinker made by the *Reed-Prentice Corp.* In place of a belt drive the top gear box is completely equipped with helical gears mounted on Timken bearings. Power rapid traverse is supplied both the cross movements (16 in.) and the longitudinal feed (48 in.). Eighteen spindle speeds from 17 to 600 r.p.m. are standard, but a high-speed range of double these speeds is available.

Some unusual universal features have been included in the No. 40 vertical miller made by the *W. B. Knight Machinery Co.*, St. Louis. The entire knee and table assembly can be swung about the column, and the table itself can be swiveled about a horizontal axis. Automatic throwouts have been incorporated in all feeds. The vertical spindle has power feed, and longitudinal table feed of 28 in. is provided at 16 feed rates. There are also 16 spindle speeds from 40 to 1400 r.p.m., read on large dials. The spindle is mounted in precision roller bearings.

Pipe Cutters

From 10 to 35 pipe nipples per min., depending upon the diameter, can be cut off in the semi-automatic *Geist* roller pipe cutter, introduced by the *Landis Machine Co.* Movement of the rollers in a vertical plane is actuated by a gear-driven disc cam. Pick-off gears give four speeds. Heavy-duty roller bearings support the disc spindle. The pipe support is in the form of a trough lined with metal strips.

It is said that an experienced operator can cut as high as 700 1-in. nipple blanks an hour with the Model F pipe cutter brought out by the *Murchey Machine & Tool Co.*, Detroit. The cutter is a disk of tool steel carried on a spindle mounted on preloaded roller bearings. Spindle drive is by a 2-hp. flange-type motor and hourglass worm. Rollers elevate the pipe to the cutter by means of a combination hand and foot lever. Pipe from ½ to 2 in. is the normal capacity.

Railroad Shop Tools

Some interesting developments in railroad shop equipment came to light in 1937. The *Niles Tool Works Co.* produced some extremely heavy-duty machines for locomotive wheel center and tire work. A highly unconventional machine for turning tire treads, for example, requires a 75-hp. motor to drive the table on which the tire is located by an electrically driven centering chuck and then clamped hydraulically. The Oilgear pump for the latter is mounted on a base that rotates with the main spindle.

The tread is turned by full contour tools, the roughing tool being carried by a right-hand side head and the finishing tool by a left-hand one. Another tool holder may be used to face the tire, in which case serrated rollers are used to drive the inside of the tire.

A heavy-duty wheel center boring machine made by the same company resembles in general appearance a vertical type miller, except that the spindle is fixed and the table, of 84-in.

IF *you have a Surface Grinder which is more than two years old, you have a problem in economics.*

Capacity—24″ x 8″ x 12″

We have solved many of these problems for our good customers, and the solution has generally been confirmed with dollars to spare by the reliable and efficient performance of this new . . .

No. 3 B SURFACE GRINDER

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ABRASIVE MACHINE TOOL COMPANY
EAST PROVIDENCE, R. I.

capacity, revolves. The massive spindle is 16½ in. in diam. Table drive is by a 25-hp. motor and when the table starts to rotate, the wheel center is locked by a self-centering chuck. The facing bar is fed horizontally through the main body of the column.

A combination machine for both wheel centers and tires resembles a heavy-duty boring mill of 118-in. capacity with two heads on the fixed crossrail. The table is driven from a 50-hp. motor and for wheel centers there is a self-centering chuck, motor driven. For rim turning operations, the casting is clamped pneumatically through the center of the wheel hub. When this machine is used for boring tires, it is provided with a seven-jaw chuck having hook clamps and self-clamping roller grips.

Another machine of rather unconventional design built by Niles is a balanced type machine for quartering locomotive wheel sets. Either boring tools for quartering or hollow turning tools for cranking may be employed. Each of the identical headstocks are mounted on ways in a 45-deg. plane but at 90 deg. to each other. When the locomotive driving wheel set is mounted in Vs in its normal balanced position with counterweight down, the center line through pins and the main axle will be parallel to these ways, and any movement of the headstocks up or down these ways will move the spindles along these respective centerlines. The set-up will take care of spindle centers for engine strokes ranging from 24 to 36 in.

Control Simplified

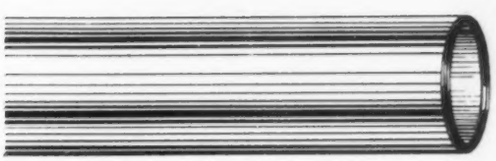
Feed and speed controls are on both sides, making it a one-man machine. The machine may be arranged for thirding by substituting bases with ways at 60 deg. to the vertical in place of 45 deg.

Simplicity of control and ease with which longitudinal and in-and-out movement of table are obtained are features of a heavy-duty vertical profile milling machine designed for railroad shop use by the *Newton* division of *Consolidated Machine Tool Corp.* Movement of the saddle and table is by hydraulic-motor screw feeds controlled by a panel of push buttons. Hand control is also provided by two follow valves that permit the table to move exactly as far as the control dials are turned only and at the rate set by the primary control lever.

Spindle head and its drive motor are built in one unit fastened to the upright. The spindle itself is mounted on Timken roller bearings and is driven by a variable-speed motor through V-belt and change gears.

Consolidated also brought out a redesigned *Betts* carwheel boring machine. The boring bar is fed hydraulically and the operating cycle is automatic. After a carwheel has been loaded on the table, the chuck jaws tighten when rotation is started. Carwheels up to 42 in. in diameter can

BISCO Tool Steel Tubing



Used In Good Machine Tools for Long Life and Economy

Leading machine tool designers use bushings of *tool steel*, for moving parts subject to heavy strains. These bushings wear slowly, and even after long service there is little increase in clearances.

Many manufacturers use BISCO Tool Steel Tubing for such bushings, saving both the labor needed to produce them from solid material and the fine tool steel wasted in chips.

The horizontal boring machine shown here, has a nitrided main spindle, running in such bushings inserted in the spindle sleeve. It was made by Giddings & Lewis of Fond du Lac, the largest builders horizontal boring and milling machines. This widely known firm has used BISCO Tool Steel Tubing for years.

Tool Steel tubing up to 14" diameter in stock.

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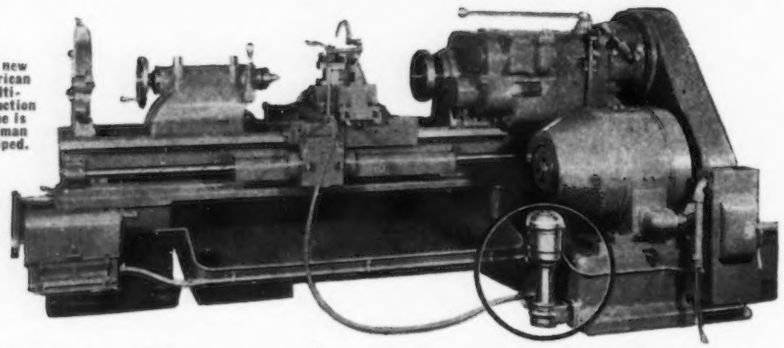

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Production-hour after production-hour, cutting tools are bathed in a constant, forceful and controllable bath of flowing coolant. Gusher Pumps need not be primed; have fewer parts to wear; packing is never required; there are no metal-to-metal contacts; and their hardened surfaces are impervious to the abrasive bite of grit and chips.

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Immersion Type

THE RUTHMAN MACHINERY CO.
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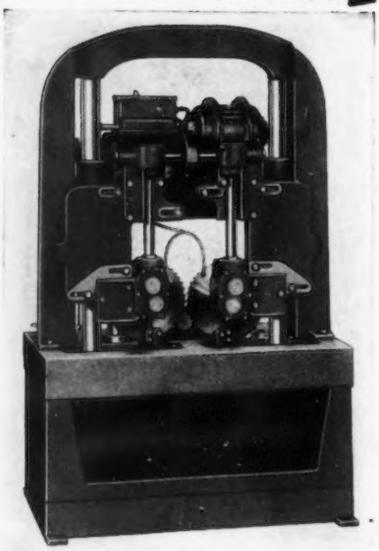
A New Step Forward in HIGH SPEED PRODUCTION SAWING

WELLS Duplex Rotary Cut-Off Saw



HERE'S a saw that's built to cut your present sawing cost 50%. Entirely new in design and principle, it has proved, under extensive research and test, the answer to high speed work. Twin high-speed circular saws mounted on a carriage which slides on vertical posts, bite into the material on each side. This principle guarantees a three fold savings. (1) Permits two cutting edges working in the material at the same time, instead of the conventional one, and the cutting time is in direct proportion. (2) Enables use of much thinner saws which reduces material waste cost to a minimum. (3) Allows use of much smaller blades—materially reducing replacement costs. These production and cost saving features combined with a controlled hydraulic feed, which guarantees accurate cut off to any length and to suit any material requirements, is your answer to perfect High Speed Production Sawing—The material savings cost alone pays for the equipment cost in a short time. Write for complete information.

Saw it the WELLS Way

WELLS MFG. CORP. Three Rivers, Michigan

regularly be handled, and by special arrangement up to 48 in.

In a *Betts-Bridgeport* center-drive lathe designed for the complete rough and finish turning of car axles and burnishing of journals, the bed ways have hardened and ground steel plates and the carriage bearing surfaces are faced with a replaceable bronze lining. Timken equipped tailstocks are also features. An end-driven axle lathe has also been produced by the same concern with similar features.

In addition, there is a burnishing lathe consisting essentially of a heavy bed, two carriages on which opposed burnishing rollers are mounted, two tailstocks and a set of ring gear chucks. The chuck is tightened on the wheel seat in mesh with the driving gear in the bed.

Planer Redesigned

The *Cincinnati Planer Co.* has entirely redesigned its frog and switch planer, which is available in two standard widths between housings of 42 and 48 in. with 24½ in. max. height under the cross rail. The main reversing driving motor of 50 or 75 hp. may be placed on either side. The cross rail can be doweled in place or provided with power feed. Two motors give independent rapid traverse to both down slides and cross saddles and each head has independent feed screws and feed rods.

Angular adjustment of the tool is obtained by worm and wheel sector cut in the tool block, and pneumatically actuated tool lifters relieve the tools on the return stroke. Other features include a bed of rigid design twice the table length and double helical gears to eliminate side thrusts.

Contour Sawing Machines

The most important factor in narrow-band, contour sawing is the correct speed of the saw for various materials. To meet this need, the *Continental Machine Specialties, Inc.*, of Minneapolis, added a dual dial control of its line of "Doall" contour sawing machines. This built-in dial gives sawing or filing speed and the pitch, temper and set for the saw to cut 48 materials.

In the "Metalmaster Doall" sawing machine introduced later in the year, the company added an indicating speed dial. This machine has infinitely variable saw speeds through a V-belt transmission with interlocking variable-pitch, double-groove sheaves. The range is from 50 to 800 ft. per min. Other new features include back and

lateral table tilt, an automatic butt welder for joining the ends of saws and a flash grinder. The machine is built with throats of 14 and 30 in. and for work up to 8 in. thick.

Four metal cutting speeds through a ball bearing gear box and one high speed by V-belt drive from the motor are available on a band saw introduced by the *Delta Mfg. Co.*, Milwaukee. Speeds range from 125 to 340 ft. per min. for metal cutting, and the wood cutting speed is 2200 ft. Capacity is for material up to 6 in. thick, but this can be doubled with an extension. Depth of throat is 14 in. Sealed ball bearings are used throughout.

Band Saw

Grob Brothers, Grafton, Wis., has made a 36-in. throat, open-end band saw, running on 18-in. diam. wheels, by adding a third pulley in the upright column of the frame, thus carrying the saw around the U of the throat. As in other models, the saw is wound helically on the lower drum which stops revolving when the saw reaches its end. This construction permits internal sawing without the need of welding or brazing. Capacity of the Type OS-36 is work 8¼ in. deep.

Earlier in the year, *Grob Brothers* added a floor-type continuous motion filing machine with 24-in. throat, designated as Type D3. Files come in flat, oval and half round shapes, and the chain can be parted for inside work. Three speeds are provided. All revolving members are carried on ball bearings. Table is 30 x 30 in.

Multiple cutting of bars in bundles has been greatly speeded up in a multi-blade saw machine made by the *Cochrane-Bly Co.*, Rochester, N. Y. An air cylinder and compound toggle clamps 40, ¼ x 2-in. or 20, ½ x 2-in., cold drawn bars held in an extended carriage fed forward by chain and sprocket. Cutting time for 2-in. lengths is reduced to 1 min 15 sec. Less than 5 sec. is needed to unclamp, feed the stock to gage, clamp and start the saw feed.

The conclusion of this article will be in next week's issue of THE IRON AGE. It will recount the progress in shapers, threading and tapping machines, lathes and turning equipment, unit machine heads and hydraulic tool mechanisms.

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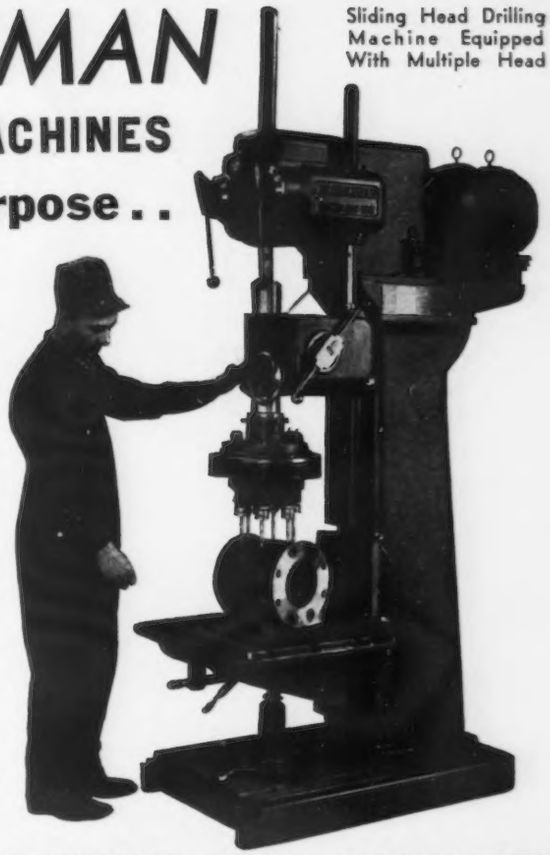

● The heavy duty drill shown is one of a complete line of drilling machines . . . It is fully geared . . . automatically oiled . . . has full anti-friction bearings . . . is furnished with plain or heavy duty compound table . . . has reverse for tapping direct through motor . . . and is furnished in a wide range of sizes.

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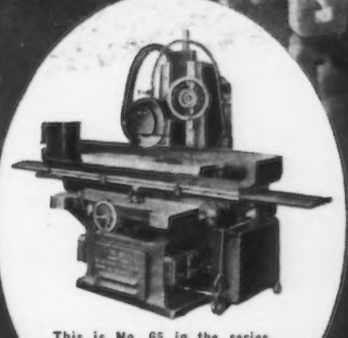

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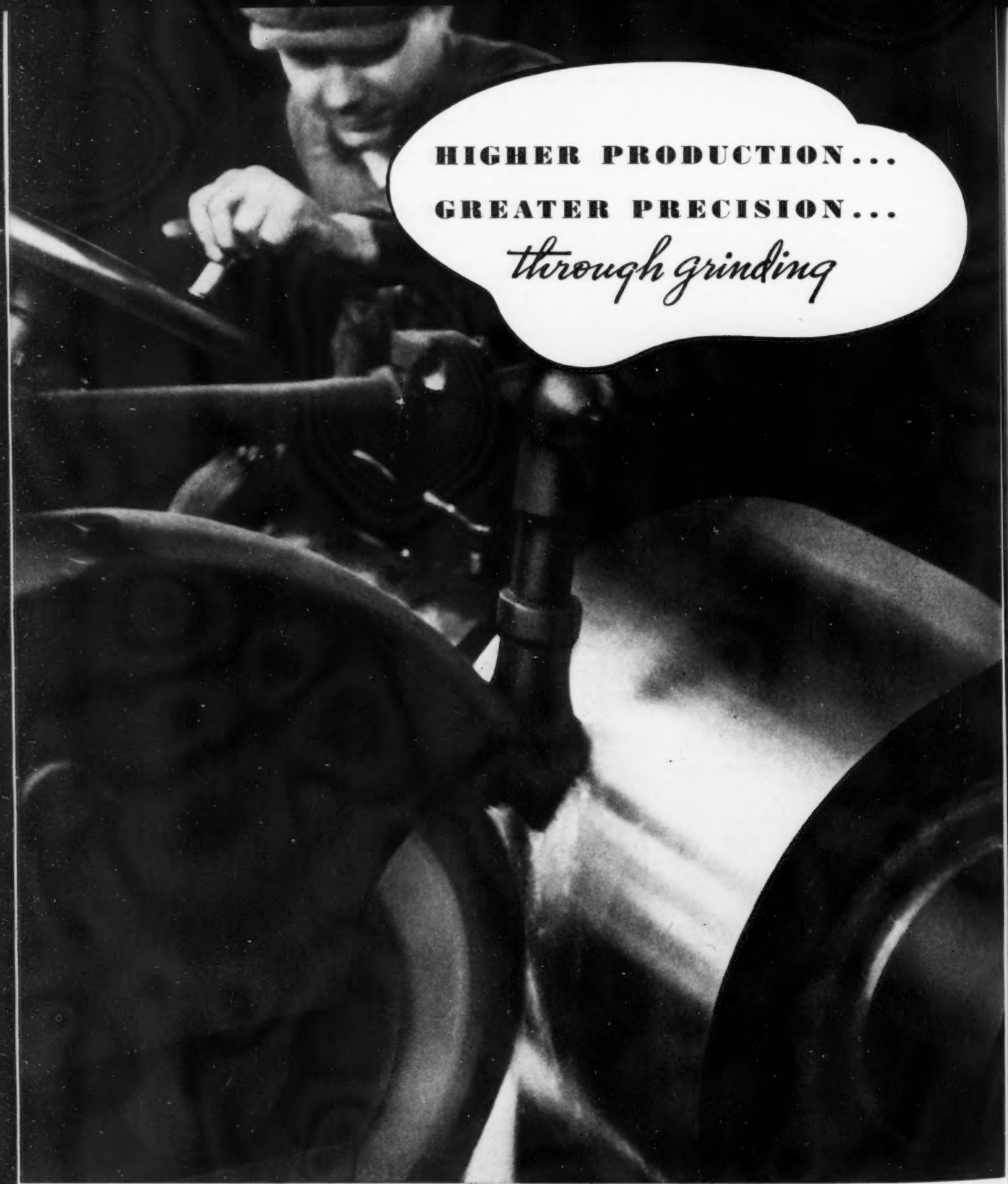

ROLL GRINDING: *Accuracy and high finish for rolled products*

A LITTLE over a century ago the roll opened a new era in the fabrication of metals. But this new process did not reach its highest development until the turning of rolls was replaced by grinding. Only then did accurate, highly finished rolls become possible. And only then was solved the problem of producing accurate, highly finished rolled metal products.

Today the improved grinding wheels of The Carborundum Company have made roll grinding an art. Accuracy and finishes undreamed of before are now possible. In no other field of grinding on work of similar dimensions are closer tolerances and greater surface perfection and finish demanded. Carborundum is indeed proud of its part in the progress of roll grinding.

And now Carborundum research has produced a new series of wheels that have set new standards of roughing, semi-finishing and ultra finishing of all types of rolls. They are fully described in "A Treatise on Roll Grinding". This valuable illustrated booklet contains forty-six pages of helpful information. It will be sent free on request.

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SMALL TOOLS AND GAGES

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° ° °

By FRANK W. CURTIS

° ° °

TO keep production at a peak and to insure minimum manufacturing costs, we must look to the importance of small tools. Care in their selection, analysis of varieties available for the purposes in mind, ease and cost of maintenance, useful life and initial investment, all must be considered. A misfit tool may turn out to be very costly, require frequent sharpenings, and result in lost time in replacements—all of which reduces output. On the other hand, through the selection and application of modern small tools it is not uncommon to obtain results anywhere from 10 to 25 per cent better than heretofore.

To get the most out of small tools, therefore, it becomes necessary to keep abreast of new developments, to attempt to find something better, and then to replace with the new when advisable. Trying to get by with something obsolete is no aid to profits.

The relation between the machine and the cutting tool cannot be overlooked, for in a general sense one is entirely dependent on the other. Many cutting tools have been perfected through cooperative developments in machine tools, and in the same light, cutting tools have been responsible for the introduction of some types of machines. This definite relation has resulted in much of the progress in shop practice, and has made possible certain manufacturing economies.

Many tools today are designed to meet specific needs, because, experi-

° ° °

FIG. 1. SPECIALIZATION even in elementary tools is dictated by service requirements.

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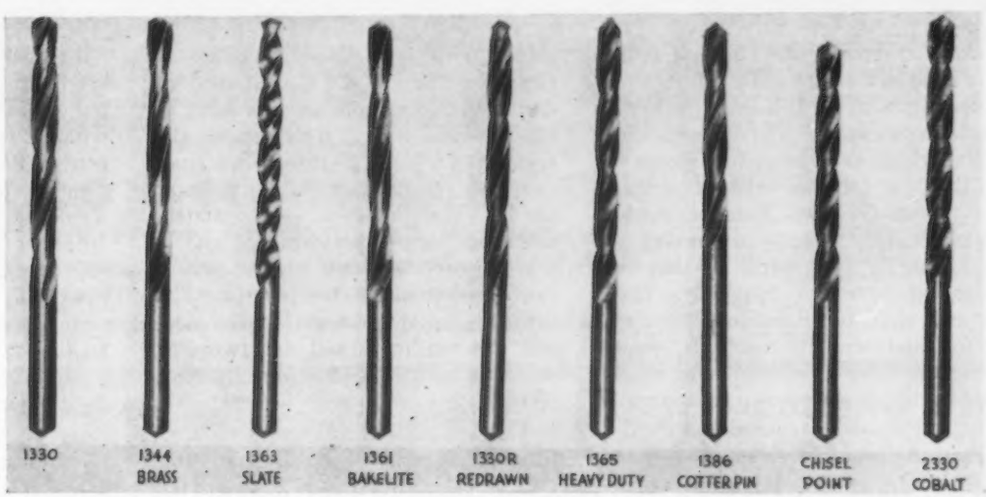


ence in the past has shown that it is far from economical to expect too much from one tool. As an example, consider the twist drill. Very few solid-type tools meet such severe service. The average drill removes proportionately more metal per minute for its size and weight than most tools, yet it should be remembered that every drill has its own scope. An ordinary drill cannot successfully drill all materials.

This is clearly exemplified in the variety of drills shown in Fig. 1, made by the Morse Twist Drill & Machine Co. All are ¼ in. diameter but each is for a specific need. The first at the left is an ordinary twist drill of usual proportions. Next is a drill for brass, made with wider grooves and slow spiral which experience has shown to be the best for this kind of service. Next is a drill for slate or marble which is just the opposite, having an exceptionally fast spiral so that the chips can be removed quickly. Then comes a drill for Bakelite, ebony, asbestos and similar materials, made along the lines of the drill for brass, but having a sharper point to ease penetration, and hardened specifically to withstand abrasiveness. The other drills illustrated likewise differ in principle and have been engineered to meet definite services.

Taps, likewise, have been designed to fit certain needs and include such improvements as precision ground taps for threads where close tolerances are required, taps with highly polished flutes to facilitate chip removal on certain materials, and spiral pointed taps, having spiral flutes a short distance back from the end, followed by straight flutes and intended for through-hole tapping on tough materials.

Much has been accomplished in tapping through the combined use of machines with high-speed spindles of rigid construction and taps of modern design. An example of this kind is illustrated in Fig. 2, which shows the tapping of a ⅜-in. 24 thread in a zinc-base casting at the rate of 1450 pieces per hr. This output is approximately twice the former performance and is representative of what precision tools can do when properly operated. The thread is cut at a speed of 1080 r.p.m., and the tap is backed out twice as fast, using a Haskins tapping machine.

Threading also has been speeded up through correctly designed equipment, and in Fig. 3 is shown a set-up for cutting a No. 10-32 thread, ⅝ in. long, at the rate of 1000 pieces per hr., using the new H & G die head. The thread is cut at a speed of 2750 r.p.m., more than twice as fast as before. An average of 75,000 pieces between grinds is obtained, which far exceeds previous runs and which has resulted in a worth while reduction in tool cost.

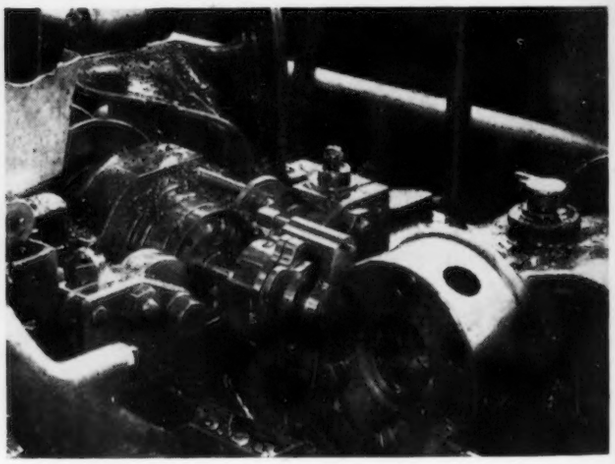
With multiple spindle set-up such as broadly used today, it is important to select small tools of the highest quality. Whether drills, counterbores, taps or milling cutters are used, the failure of one tool may seriously handicap production. When selecting small tools, therefore, it is well to carefully analyze the design, be sure the correct type and grade of steel is used in its construction and that it has been properly and uniformly heat treated. A small saving in the original cost is not always wise because such factors as sharpening, time lost in replacing and loss in output can easily offset slight purchase gains. This can be visualized easily in the case of the multiple spindle set-up, illustrated in Fig. 4, a Sundstrand "rigidmil" used for finishing 12 locating surfaces on crankshaft forgings, with 12 side milling cutters, at the rate of 40 pieces per hr. Any development of cutter trouble on such a set-up would very likely affect the output of an entire line, therefore, it is obvious that the best in the way of small tools is actually the only choice.

A recent development of inserted-blade milling cutters is one brought out by the McCroskey Tool Corp., shown in Fig. 5. The feature of this cutter is the grinding of the blade serrations after hardening. The advantages of serrated blades have been

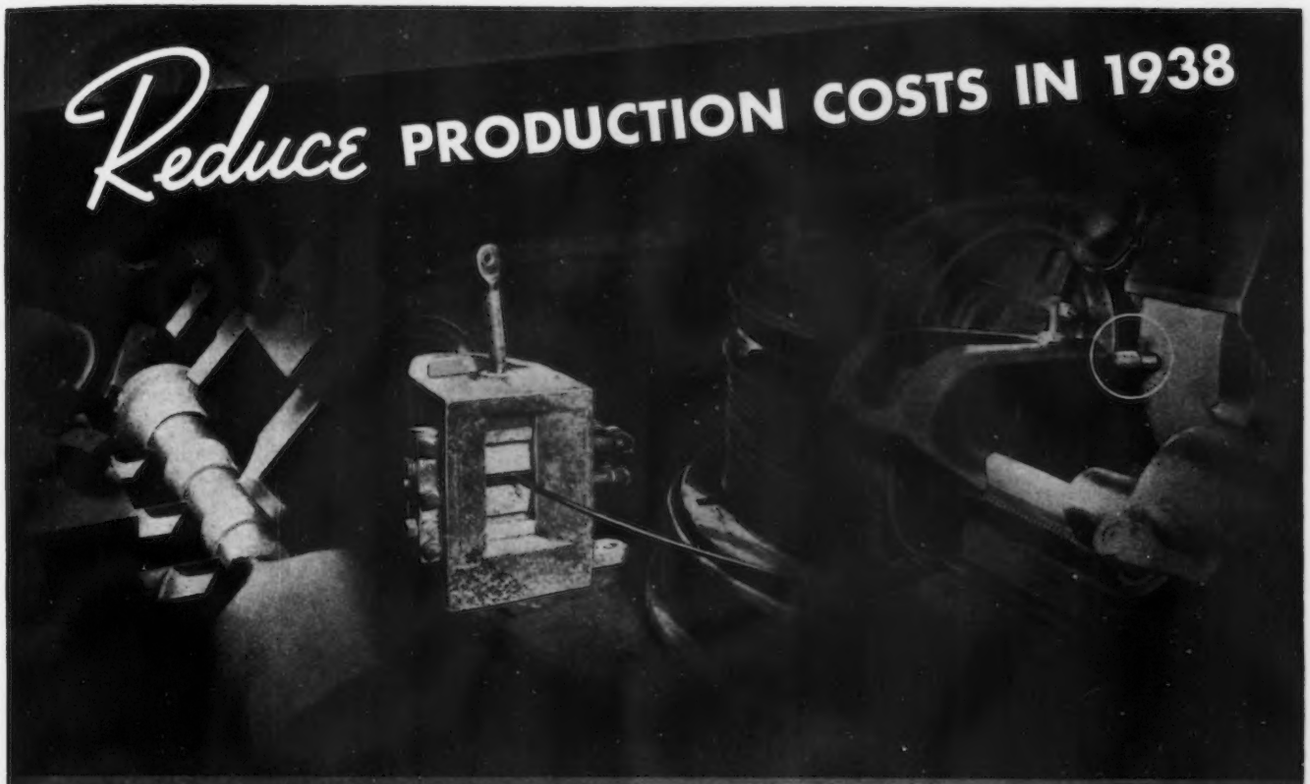
FIG. 2. HIGH-SPEED tapping gives an output of 1450 pieces per hr. on this zinc base casting.

o o o

FIG. 3. BELOW THREADING has also been put on a high speed basis, as exemplified by a production rate on this job of 1000 pieces per hr.



Reduce PRODUCTION COSTS IN 1938



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**DIES—CUTTING TOOLS
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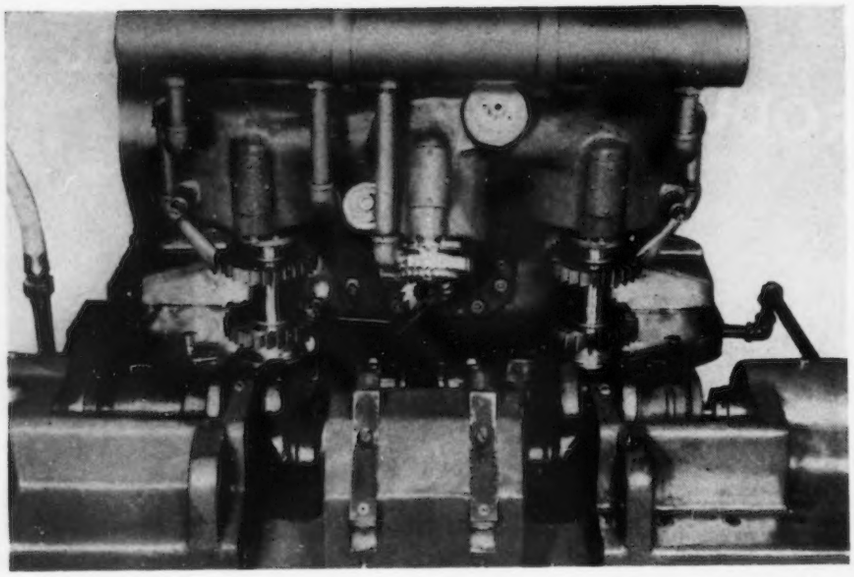

tool economies offered in this field. Not all flat-surfaced parts fall in this classification, but quite often by modifying the design of a workpiece it can be made sufficiently strong to withstand the pressure of broaching, which of course, is of primary consideration.

A representative type of surface broach is shown in Fig. 6. The part finished by this broach is a forged transmission bearing, shown in the rough on top the broach at the left, and at the right after having nine surfaces finished. The broach is made in sections, each insert being designed so that it will hold size after several sharpenings. Made by the Detroit Broach Co., it is used in a vertical

fully recognized because of their positive holding ability, even under severe use. Heretofore, however, serrations have been finished before hardening with the result that any warpage of the blade affects the desired fit and may result in slippage.

This is overcome by ground serrations which offer a more perfect mesh, as well as an aid in making blade adjustment somewhat easier. Each alternate tooth in the blade is omitted, forming a flat bottomed groove that facilitates grinding. The body slot, however, carries the full number of serrations. Through this combination no change is made in the increment of adjustments. Serrations of high-speed steel and Stellite blades are ground from the solid after hardening, while tungsten carbide-tipped blades are ground after brazing.

FIG. 4.
ABOVE

IN multiple tool operations, the ability to withstand tool wear is a prime factor in accurate quantity production.

o o o

FIG. 5.
AT RIGHT

BLADE serrations in these inserted teeth are ground after hardening.

Surface Broaching

Surface broaching has made rapid advancements during the past year or so, due perhaps to the tremendous opportunities in production and overall

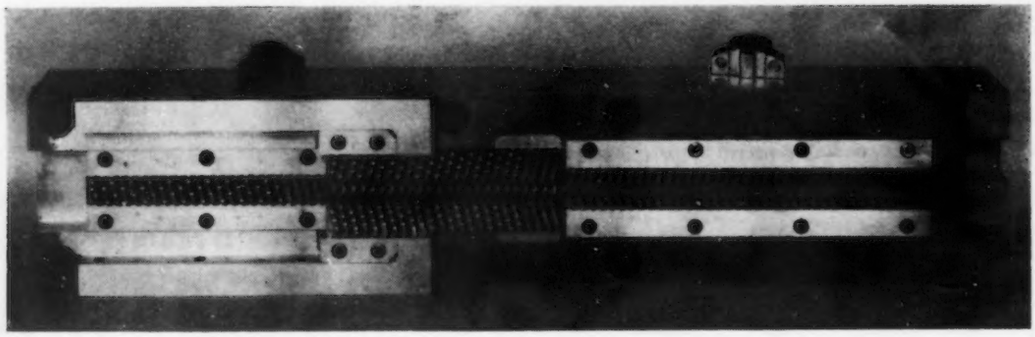

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FIG. 6.

NINE surfaces of a forged transmission bearing are finished by this broach.

o o o

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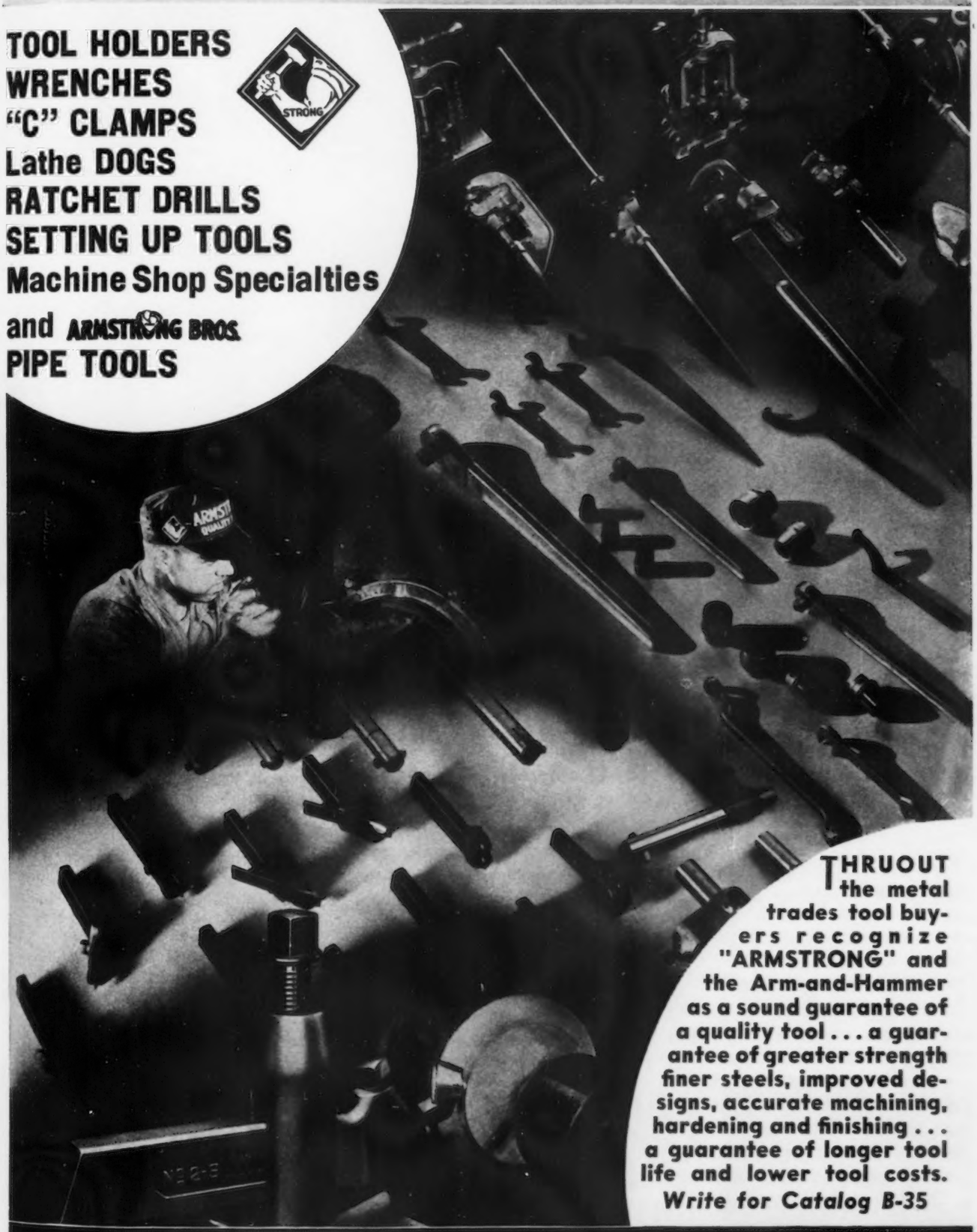

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ARMSTRONG BROS. TOOL CO. *"The Tool Holder People"* **CHICAGO, U.S.A.**

broaching machine and produces 1200 pieces per hr.

Another broach of similar design, by the same company, is for finishing bearing caps. It completes the half bore, two flat surfaces and the bearing lock in one pass. Such a set-up makes possible the combining of several cuts into one, insures accuracy and provides a smooth finish. Tool cost per piece is also reduced even though the initial investment is usually higher.

Broaches also have been developed to handle exceptionally wide surfaces, in which case, instead of having broach sections made with several integral teeth, as shown in the preceding examples, each tooth is made as a separate insert and clamped into a slotted body. This form of design affords much latitude since the teeth can be notched, staggered, straight or angular as may be needed, and likewise can be sharpened separately. Different tool materials can also be used, such as high-speed steel for the roughing section and tungsten carbide for finishing, all in the same broach.

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FIG. 7.

CYLINDER block ends are broached in this set-up at the rate of 48 pieces per hr.

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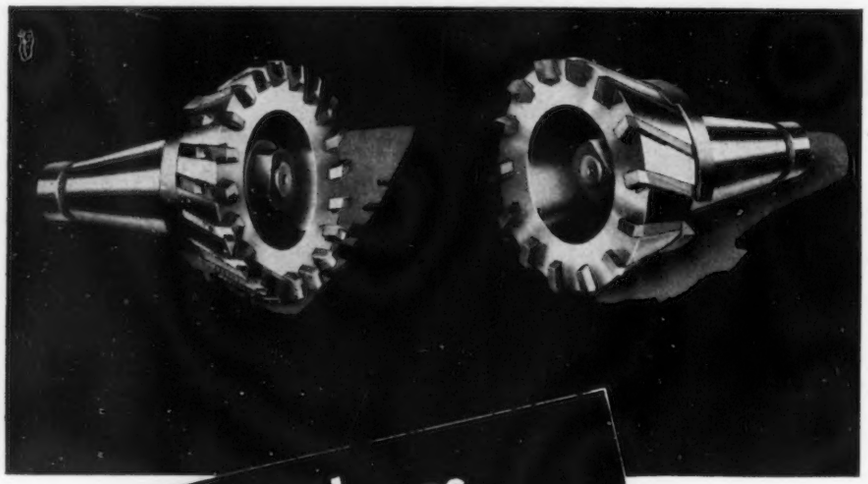
An excellent example of a large broaching set-up, recently developed, is illustrated in Fig. 7, which clearly shows the possibilities of this type of operation for finishing wide, flat-surfaced parts. The operation is that of broaching both ends of cast iron cylinder blocks in a Cincinnati broach, removing 3/16 in. of material on each side, at a speed of 30 ft. per min., and producing 80 pieces per 48-min. hr. The cutter inserts are mounted on the inside of two stationary columns. The cylinder block to be broached is mounted in a cradle-type fixture, located on the end of a piston rod, and is forced vertically past the cutters. The block is automatically removed at the end of the stroke to a shelf at the rear of the fixture, so that it clears the cutters on the return stroke. At the end of the cycle the finished block is automatically pushed off the shelf at the same time a new block is pushed into the fixture. The only function of the operator is to have a cylinder block in the proper position for loading and to operate a push-button switch that



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Announcing

Gair-Lock Milling Cutters and Blades, which reduce down time by making blade adjustment quick, easy and simple, and by minimizing cutter maintenance.

This important advance in blade design also provides greater chip clearance, increases blade life, decreases blade cost.

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The Gairing Tool Co. Detroit, Mich.

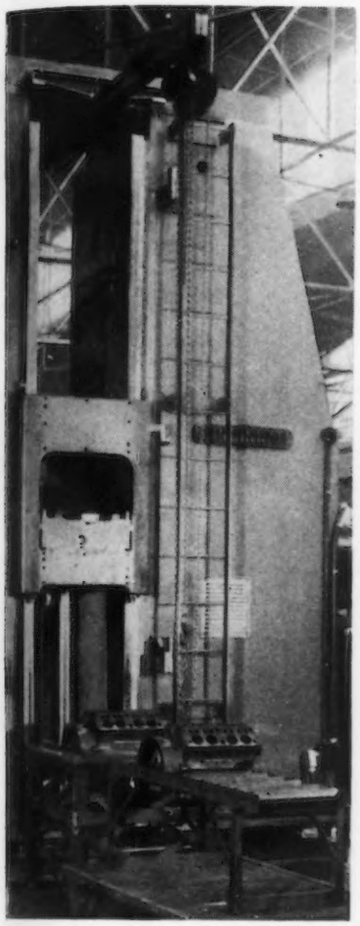
MILLING CUTTERS — COUNTERBORES — SPECIAL TOOLS

Blade GAIR-LOCKed in position in cutter head. Patent Pending

GAIRING LOCK

MILLING CUTTERS

SHELL, SIDE, FACE, INTERLOCKING AND ALTERNATE TOOTH



starts the automatic cycle, including locating, clamping, broaching, unclamping and ejecting. Tungsten carbide inserts are used for the finishing teeth, so that smooth, accurate surfaces are assured.

Stellite

When Stellite was introduced many years ago, it was the first cutting material that permitted the use of speeds higher than those used for high-speed steel. In many cases, metal could be removed about 50 per cent faster, but the field was limited to certain types of operations and progress was inclined to be slow. Composed of chromium, cobalt and tungsten the original Stellite was somewhat brittle and the technique for use was not properly carried out. As time went on, however, toughness was increased and Stellite became a universal material for production purposes, and the choice for a wide variety of cutting tools.

A few years ago Stellite J-metal was introduced, its qualities permitting the use of slightly higher speeds, with the assurance of longer life between grinds, so that it has largely superseded former grades and has since established itself as a superior cutting alloy.

Now, a new material has been introduced, known as Stellite-2400, which permits the use of cutting speeds even higher than those used with J-metal, and which more suitably machines various types of steels, including steel castings, stainless and the tougher alloy steels. The average speed increase is about 25 per cent, using about equal feeds and depths of cuts.

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THE concluding part of this review will appear in The Iron Age of Jan. 13. It will deal with additional developments in the application of the various carbides in small tool practice.

"DYNO-MITE"

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No. 400
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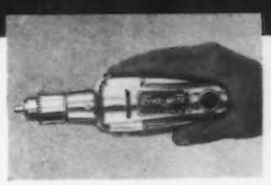
PRODUCTION
DRILL



Top view showing how streamline design fits "Dyno-Mite" to the grip.

Side view showing relative size of "Dyno-Mite."

World's finest ..STREAMLINED HANDFUL OF POWER

Actual working tests have shown conclusively that this little giant has no equal in the small production drill field. Here is a powerful, practical tool, capable of sustained high speed production WITHOUT OVERHEATING. Perfectly balanced and ingeniously ventilated, it can be operated indefinitely without discomfort. It is not only the smallest, lightest ¼-inch drill on the market (2½ lbs.) but also the most powerful. For work of a one-handed nature, no other drill ever made can be handled with such perfect control and so little fatigue.

Its simplicity of design and construction denote the skillful engineering of a finished tool. It can be taken down and reassembled in five minutes. Quiet operation and long life are assured by heat treated chrome molybdenum helical gears, oversize Oilite spindle bearing, ball bearing armature and thrust bearings.

Write for complete details of this remarkable new drill and of the many other fine power tools in the Millers Falls line. Ask us to demonstrate "Dyno-Mite's" superiority on your own work.

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MILLERS FALLS COMPANY
Greenfield, Massachusetts

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PITCH OF TOOTH
SPEED OF BLADE
FEED PRESSURE
ALWAYS PLACE THE BLADE IN FRAME WITH TEETH POINTING AWAY FROM OPERATOR
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STAR MOLY
HALF GROSS
EXTRA VALUE
HEAVY DUTY
HAND BLADES
STAR HACK SAWS MOLY
THE STAR HACK SAW
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FORMING *and* FORGING . . .

Closer dimensional control reduces machining. Grain size requirements stiffening. Press speeds increased with proportional gain in output. Uses expand in many industries.

By F. L. PRENTISS

MUCH progress was made in the forging industry in 1937 in the production of forgings with dimensions closer to the desired finished size, thus reducing machining costs in increased speed of production, in broadening the field for forged parts in the transportation and other fields and in more numerous applications of stainless steel forgings. Corrosion-resisting forgings found new markets in the oil and other fields.

Manufacturers of equipment are giving a great deal of attention to the reduction or elimination of dead weight and forge shops are meeting this demand for parts that are lighter without sacrificing strength. The same may be said of reciprocating parts.

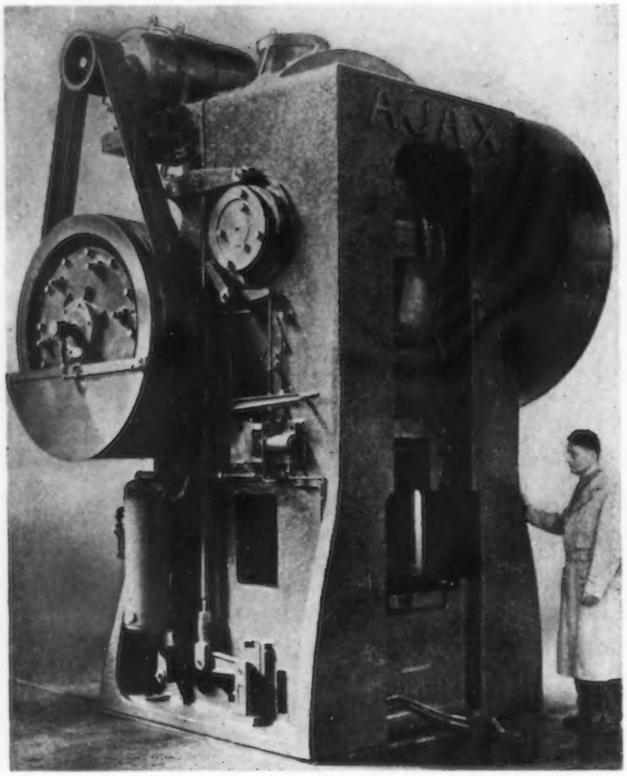
Responding to the call for forged parts with closer tolerances, forgings within 1/16 in. to 1/32 in. limits and even closer are now being made on medium size drop hammers so that no finishing is required except on bearing surfaces, thus almost entirely eliminating machining. Press forging is on the increase. With the increased cost of labor, forgers continue their efforts to make forgings of closer tolerances in order to cut down machining costs. One way is by hot and cold coining. Applications of hot coining have become quite numerous. One forger is now coining heads for golf clubs and putting serrations in the blade in the same operation, doing away with machining. Formerly the serrations were machined or made with roller dies. After the head is forged, trimmed and planed, it is put in a coining die and sized, producing a smooth surface. There are serrations in the die which at the same time are forced into the face of the blade, producing the required serrations.

Users of forgings are paying more attention to grain size and many now specify the grain size that will meet their requirements. When toughness and resistance to shock is wanted fine grain steel is usually called for. However, coarse grain steel has better machineability than the fine grain material. Forgers have become more particular in their steel requirements, demanding that mills supply them with steel free from surface defects.

A trend towards the use of more forged parts is in evidence in the automobile, truck, tractor, machinery, road machinery, mining, general industrial equipment and other fields, according to the Drop Forging Association, which finds the gain particularly noticeable in the aircraft industry, which is using more duralumin as well as steel forgings. The institute's figures show that automobiles and trucks take 67 per cent of the output of commercial drop forge plants, agricultural implement manufacturers 10 per cent, railroads 6½ per cent, and machinery manufacturers 6 per cent.

An increased use of forged high pressure pipe fittings, largely by the oil industry, is reported and also an increased production of brass forgings for hydraulic fittings in the plumbing and other industries. Advantages claimed for the forged brass fittings include greater reliability and decrease in number of parts that are scrapped during machining because of porosity and blow holes.

Stainless steel forgings are being more commonly used, particularly in the oil industry, for valves, pumps and other refinery equipment where steel that will resist high temperature



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AJAX 1000-ton solid frame forging press equipped with air clutch.

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and high pressures is required. Diesel engines are also using more stainless steel forgings for combustion parts. Forgers who have had considerable experience in forging stainless steel stress the need of careful heating of the steel in forging furnaces having pyrometric control.

The trend in the forging machinery field last year was toward heavier, more powerful and speedier machines. There were refinements and improvements in existing models, but no radical changes in design.

Construction of steam drop hammers of much larger size than heretofore was the outstanding development of the year in the forging equipment field. For making diesel engine crankshafts and other heavy forgings a 35,000 lb. hammer, the largest to be built in this country, is being installed in a Cleveland forge shop and is expected to be placed in operation this month. Crankshafts of a size that are to be forged on this hammer are now being forged on flat die hammers instead of being drop forged in impression dies. With this immense hammer diesel engine crankshafts will be forged like automobile crankshafts with the throws and pins in position. It is stated that this hammer will have a capacity for making crankshafts up to 10 ft. to 12 ft. long.

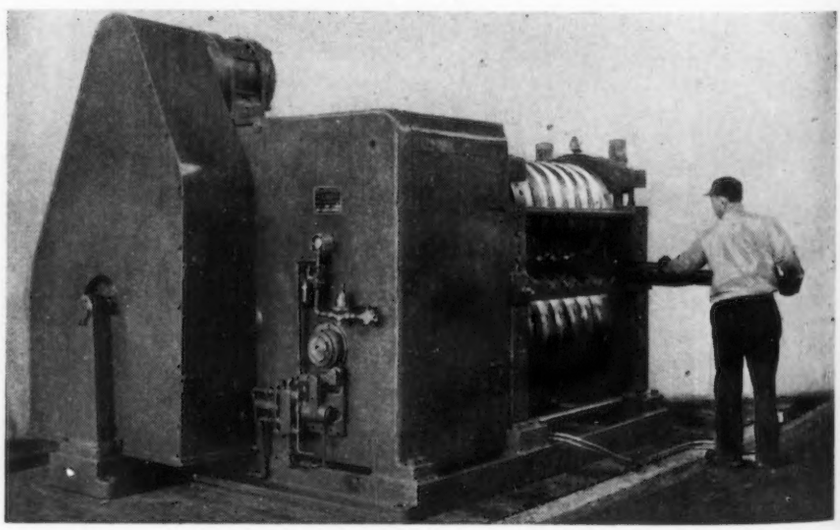
A 50,000-lb. steam hammer is also being built by the same manufacturer for export. A year ago the largest hammer in operation in this country was of 25,000-lb. capacity.

Life of forging dies is being increased by the more general use of alloy steel dies having a tungsten, molybdenum or other alloy content. Forgers are demanding longer life dies for long production runs.

Hammer design has changed little during the past year, this being true of both steam drop and board drop hammers. The latest model steam hammer is what might be termed the streamline type of 1933, which was not changed basically in 1937, according to R. E. W. Harrison, vice-president, Chambersburg Engineering Co., Chambersburg, Pa. However, he states that there is a growing appreciation on the part of the users for economy of upkeep, the reduced steam consumption and the hard-hitting qualities of this tool. Another interesting factor entering the situation, says Mr. Harrison, is a growing appreciation which users abroad have for the American drop forging technique and this has resulted in a greatly increased foreign business.

An interesting trend Mr. Harrison states is the increased use of compressed air as a power medium at the expense of steam. He believes this is due to the initiative of the power companies, which wish to supply power in the form of electric current, plus a feeling on the part of many users that air is more economical than steam for shops employing up to half a dozen hammers, particularly when costs are reviewed on a 12 months' basis.

A 35,000-lb. steam drop hammer for making diesel engine crankshafts and other large forgings, previously referred to, is being built by the Erie Foundry Co. for the Park Drop Forge Co. Its total weight will be well over 300 tons. The weight of the ram, piston rod, and piston will be about 38,000 lb. The piston rod will be 10 in. in diameter, the cylinder bore 30 in. and the stroke 65 in. The ram will be



AJAX wide adjustment forming roll.

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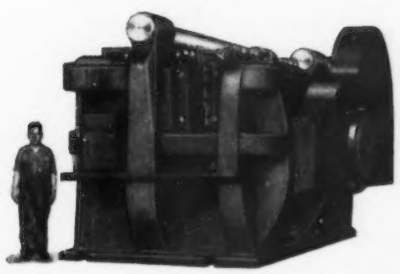
Rather than rush into spasmodic engineering activity in a belated and futile effort to catch up with Industry's demands, with us it is a matter of principle to *anticipate* and supply Industry's needs.

The practical value of this policy is that users of High Duty Forging Machines are conscious of the fact that their National Forging Equipment embodies every worth while feature . . . . . that National Pioneering is responsible for the speed, accuracy, range and capacity . . . . in fact for the basic improvements which make possible the low weight, minimum finish forgings of today.



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New York Detroit Chicago

32 in. in the clear between the guides and both the ram and the sow block will be 110 in. from front to back. The sow block will be supported by the anvil throughout this length. It is expected, however, that the die blocks will overhang the ram and the sow block slightly, as the hammer will be used for making some very long forgings. Heavy crankshafts up to 8-throw 9-bearing shafts with crank pins 8 in. in diameter will be drop forged on this hammer.

A new feature in its design is the use of four guides for the ram, each guide having three of the customary 60-deg. V's. Each guide will be separately adjustable so that it will be possible to correct angular misalinements of the dies by means of guide adjustment.

This feature will also be included in the 50,000-lb. hammer which is being built for export and which also will have a new anvil construction due to limitations imposed by transportation facilities at the point of installation. The anvil will consist of four sections, each weighing 110 tons. The diameter of the piston rod will be 11½ in., the cylinder bore 39 in. and the stroke 72 in. The ram will be 50 in. in the clear between guides and the distance front to back will be 80 in. The handling and machining of these heavy anvil sections will require some of the largest cranes and machine tools that are available and some of the features of the design, it is stated, will call for an accuracy of machine work rarely required on such heavy parts.

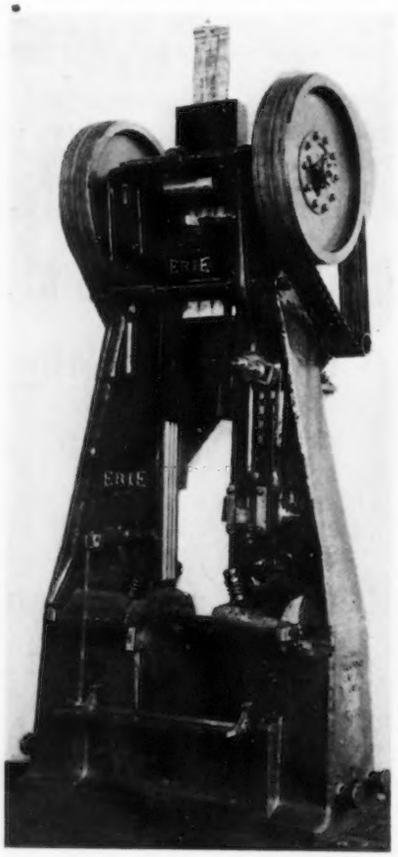
The outstanding feature of his company's business during the past year has been the size of the steam drop hammers and the number of the large hammers that have been sold, states Macdonald S. Reed, Erie Foundry Co., Erie, Pa. In recent years a 12,000-lb. hammer was the largest that was in widespread use, although there were quite a few with larger ratings. Many of the 12,000-lb. hammers built in previous years had less than 20:1 anvil ratios and the total weight of such a hammer might be about 250,000 lb. With present design with higher anvil ratios and heavier construction throughout, some 12,000-lb. hammers have a total weight of 420,000 lb.

The year's business in hammers larger than 12,000 lb. included units with ratings from 14,000 lb. to 26,000 lb. in addition to the two larger hammers previously mentioned. A 20,000-lb. hammer was built to handle dies 9 ft. long front to back for forging aluminum alloy parts. The above are all rated sizes nominally the weight of the reciprocating parts, but Mr. Reed states that in all cases actual weight of the ram, piston rod, and piston and not including the top die will exceed these figures.

The average size of the 41 steam drop hammers included in the business taken during the year was 7700 lb., which Mr. Reed states is a striking figure considering that there were some 1000 and 1500-lb. steam drop hammers included and that the corresponding average size in previous years had been between 3000 and 4000 lb. The total weight of these steam drop hammers was almost 10,000,000 lb., made up almost entirely of steel castings and steel forgings.

Conspicuous progress in forging practice in the automotive field last year was shown in the use of a 16,000-lb. hammer by the Buick Motor Co. for forging crankshafts. This Chambersburg hammer, installed late in the previous year, supplemented Buick's 12,000-lb. hammers. With the larger hammer capable of heavier blows the number of blows has been sharply reduced, thus cutting down the forging time.

For deep stamping, light weight, high strength sheet metal parts, particularly for use in aircraft construction, a pneumatic drop hammer was brought out by the Chambersburg Engineering Co. This hammer was designed to accommodate the lead and zinc dies used on rope lift hammers.



ERIE board drop hammer of the self contained V-belt drive type, the drive being from two motors mounted on the frame of the hammer.

Forging machine design, like hammer design, did not undergo any radical change last year, but these have been improved in various ways, the improvements being more in the nature of refinements. With the use of the high duty forging machine with the refinements that have been added jobs that only a short time ago were classed as impractical stunts are now commonplace, everyday production jobs, declares R. H. Jones, National Machinery Co., Tiffin, Ohio. Reviewing accomplishments with modern forging machine equipment Mr. Jones says that it is no longer necessary to accept the enormous waste of antiquated forging methods. The practice of allowing ⅛ in. or more for finish, providing excess draft to get the forging out of the die, and excessive flash in order to fill the forging is entirely out-moded. The rigid unyielding bed frame of the modern forging machine makes it unnecessary to throw a large flash on the forging in order to properly fill out all the die impressions. It is obvious, Mr. Jones points out, that nothing could be more expensive than to heat, forge and then throw away a large part of the steel required in making the forging by expensive trimming and "hogging-off" operations. The shop equipped with modern machines produces low weight, minimum finished forgings, many entirely without flash, thus eliminating trimming and roughing cuts in the finishing operations. Furthermore, he says, gears, sleeves and similar parts are forged complete with holes ready for broaching.

"There was an outstanding trend toward press forgings during 1937," according to W. W. Criley, general manager, Ajax Mfg. Co., Cleveland, in reviewing developments in the forging industry and in forging machinery during the past year.

"Important reasons for this trend are that the speed of production of forgings on presses is equal to or higher than on hammers, it takes less skill to operate forging presses than hammers and the life of dies used on presses is satisfactory when made of suitable die steels, the impressions are properly sunk and discretion is shown in the selection of forgings to be made on presses. However, the factors that have shown the greatest influence in

the trend toward the use of forging presses are their greater dependability and lower operating and maintenance costs than either board or steam hammers. Forging presses are not adaptable for making forgings in which the stock must be extruded into deep die impressions, when the stock cannot be totally confined and when there must be a parting line in the dies for flash.

"We are now building solid frame forging presses to operate at speeds formerly regarded as impossible, being able to attain these high speeds by equipping the machines with air clutches. Strokes have been doubled over the older designs, now being approximately 60 per min. on the 2000-ton machine and more than 100 strokes per min. on the 500-ton machine. However, safety has not been sacrificed with increased speeds, as the clutch will not reengage when the press drifts by the top dead center from any cause."

The Ajax Mfg. Co., Euclid, the past year rounded out its line of solid frame forging presses, which it is now making in capacities up to 2000 tons. The forging rolls of this company have improved adjustments, improved matching of rolls and more powerful drive and also are now equipped with an air clutch for starting and stopping. This company also during the year brought out a welded frame bulldozer having an improved method of guiding the cross head. Rigid support for the main eccentric gears is assured by integral hubs extending into the main bearings. This bulldozer has a novel reversing drive with belt connection to the motor as compared with bevel gear and pinion drive.

HIGH speed muffle furnace in center with atmosphere control for hardening eye bolts, shackles and U-bolts. Work is preheated in the furnace at the left and drawn in the pot furnace at the right. Installation by Surface Combustion Corp.

Improvements in forging furnaces were made during the year to more closely control the temperature and atmosphere and new features were

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Patented in the U.S. and Canada

Bends Pipe, Bars and Angle Iron

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It does a perfect job on Pipe work, bending to any degree or to a continuous coil without flattening it or splitting the seam.

The bending of Angle Iron is an exceptionally wonderful feature of the machine. It forms a smooth perfect curve or circle of any radius desired, without twisting or distorting the stock in the least. It also bends Sharp Square bends on notched Angle Iron.

The machine is built in two sizes. The larger size bending up to 2-inch standard pipe, 4½-inch flat bar stock, or 2x2x5/16-inch angle iron, cold. There are thousands of these machines in use by all classes of trade in the U. S., Canada and other foreign countries.

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provided in some furnaces that were designed to meet the particular requirements of the customer.

"It has been our experience," says the Surface Combustion Corp., Toledo, Ohio, "that the past year rather than witnessing new developments in forging furnaces, has been one in which the trend has been to improved furnaces with automatic control of temperature and atmosphere. The importance of proper and closely regulated heating has undoubtedly been brought about by the demands on the producers of forgings for closer tolerances in dimensions and more rigid specifications as to decarburization and scale.

"A practice which has come into more general use during the past year has been the upsetting and drawing out of seamless steel tubing into banjo rear axle and differential housings. This practice seems to be replacing the older practice of making the differential carrier of malleable iron into which was pressed and then riveted or welded steel tubes to make up the remainder of the housing."

The very nature of the work to be heated for forging is of so varied a character as to necessitate continued improvement in design and construction of forging furnace equipment, declares W. F. Ross, Electric Furnace Co., Salem, Ohio. Among recent forging furnace designs of interest, Mr. Ross mentions an oil fired rotary type end heating furnace for continuously heating the end of miscellaneous forgings prior to hot working. This furnace has a circular tunnel type chamber with a 2-in. slot through the outer wall and the entire equipment revolves on its axis on a rail supported by track wheels. The stock is laid within the slot, projecting the required distance within the furnace chamber. As the furnace revolves it becomes gradually filled with the pieces to be heated and when it completes the circuit a heated piece is removed for forging and cold piece put in its place. This furnace, it is stated, has a production of 250 to 500 pieces per hr., based on heating approximately 8 in. of one end of each piece of stock.

A high temperature furnace with rotary hearth, according to Mr. Ross, has proved especially valuable for heating bars or billets that can be easily handled with tongs. The hearth of this furnace is independent of the furnace and revolves within the furnace chamber. Pieces are laid radially in succession upon the slowly revolving hearth. Operating economy, it is said, may be effected because it is possible for the hammer man to charge cold pieces and remove heated pieces from the chamber according to production needs.

A new oil fired forging furnace which is claimed to effect a marked saving in fuel, reduction in scale through control of the atmosphere enabling the operator to maintain a reducing atmosphere, reduction of soft spots by atmosphere control and rapid heating, recently was developed by the Eastern Refractories Co., Inc., Boston. While several furnaces of this type have been built, the commercial development has not yet progressed to the point of manufacturing a standard type furnace.

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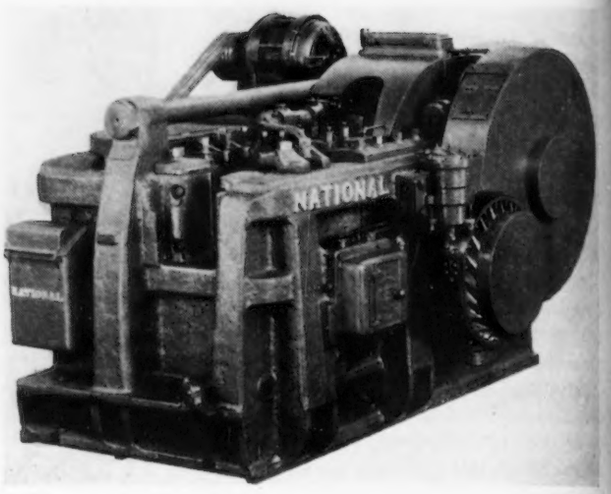

LATEST type of National forging machine.

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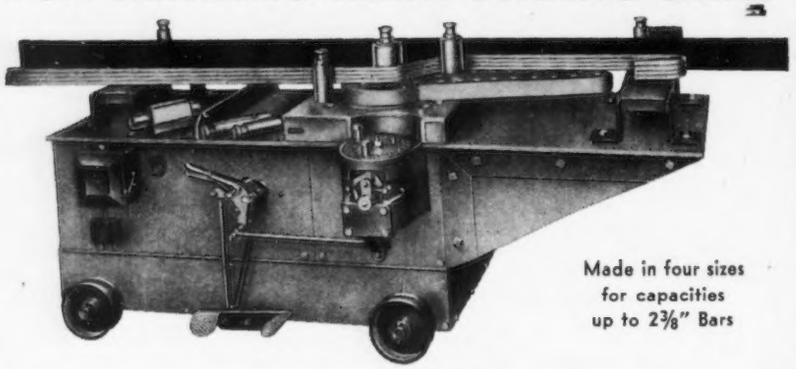
AUTOMATIC MOTOR DRIVEN
BENDING MACHINE
FOR BENDING REINFORCING BARS



Made in four sizes for capacities up to 2⅜" Bars

Bends one or more bars at a time and makes 2 bendings simultaneously—Bends Hooks, and Angles on Truss Bars, Stirrups Rings, Spirals, Bows, etc. All bending automatically controlled. Cuts production costs.

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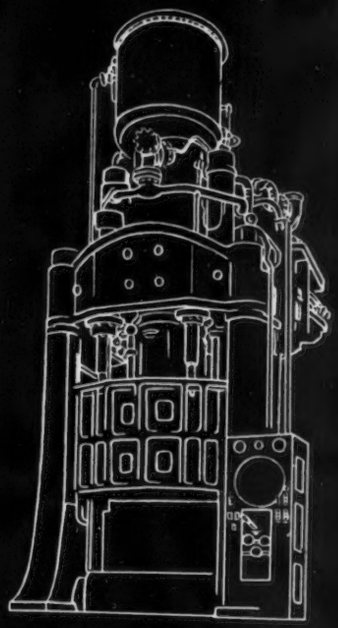
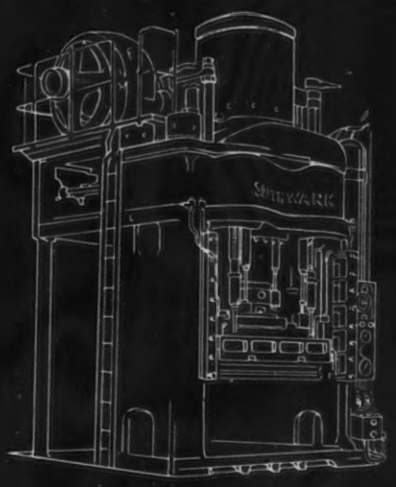
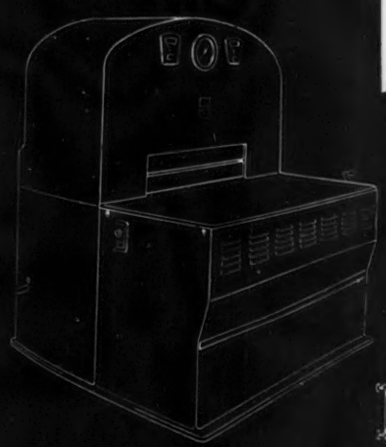
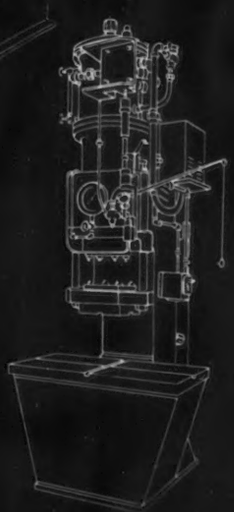




SOUTHWARK PRESSES





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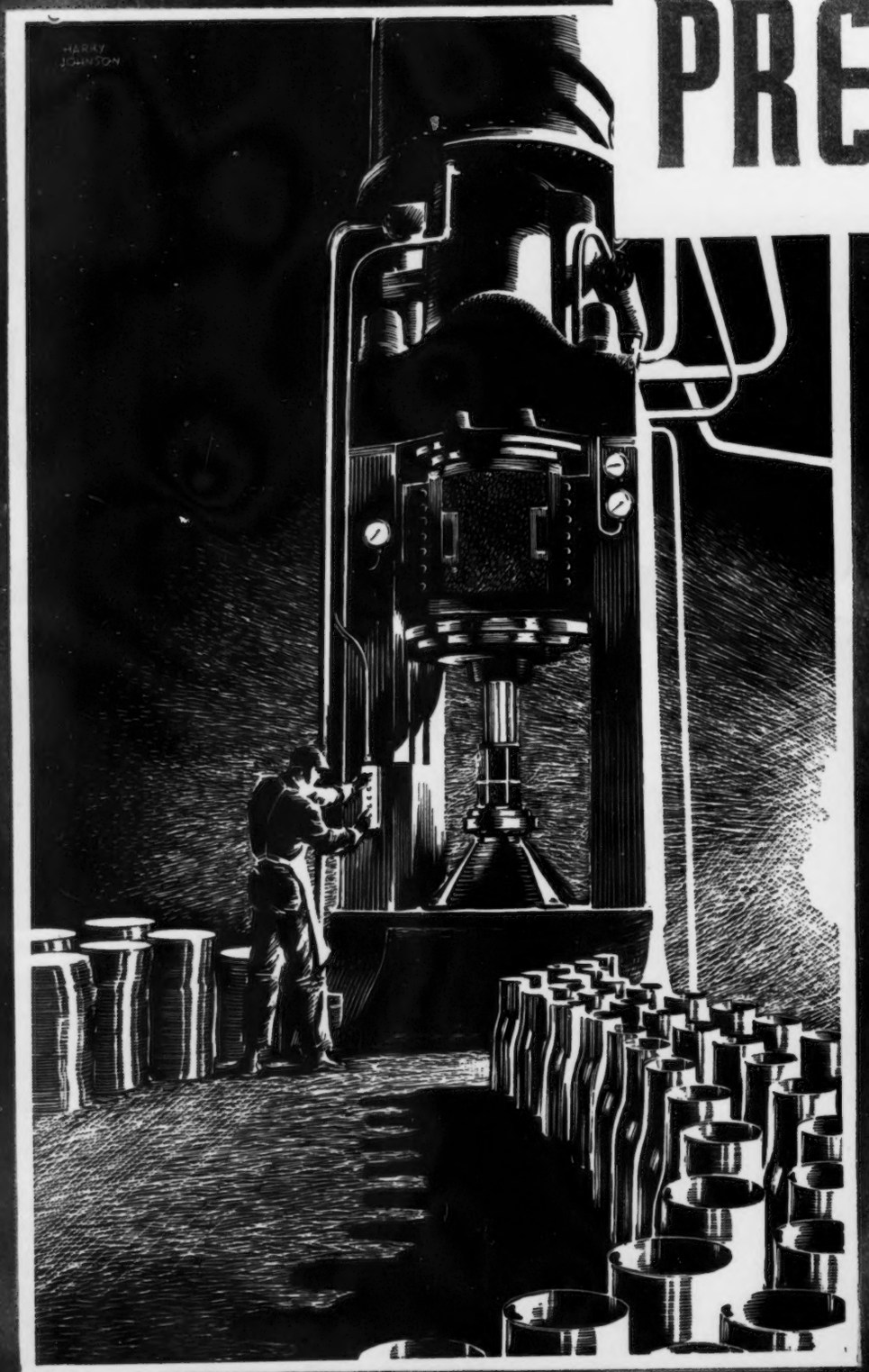
THE PELTON WATER WHEEL CO. San Francisco

PRESSES



AND SHEET METAL
MACHINERY

PRESSES

AND SHEET METAL MACHINERY

Principal developments are increases in capacity and power, extension of welded construction, improvement in pneumatic, electric, magnetic and hydraulic controls.

THE past year has seen much of the experimental work of preceding years finally brought to fruition. Marked progress has been made along three definite lines; (1) in the building of heavier, more powerful presses to perform operations considered practically impossible as recently as 1930, (2) in the use of welded steel construction and solid cast band type frame construction to secure greater rigidity of structure for precision alinement of dies in high-speed automatic work, and (3) in the use of improved pneumatic, hydraulic, electric and magnetic controls, to secure quicker operation with a greater degree of safety.

More attention all around has been devoted to the efficient operation of presses, to the closer coordination of feed movements on automatic equipment, and to many refinements of design which result in more work in any given period of operation, with a maximum of safety and at a minimum operating cost. In short, the objectives of the past year may be summed up in the phrase "higher quality output and more of it, at lower cost."

In the opinion of Chief Engineer R. B. Treer, of Cleveland Punch & Shear Works Co., "One of the outstanding contributions in the field of power press equipment in the past year has been the development of means for the *accurate* measurement of coil stock, by means of roll feeds synchronized with the press. These automatic feeds, which are capable of handling the largest rolls of coiled stock, measure the material to an extreme accuracy while feeding it to the press or squaring shear. Other advances in power press design include the relocation of the driving mechanism and inclosing it in oil-tight housings. This important change has resulted in a more compact arrangement, decreased overall height, and promoted the more economical use of floor space."

In the realm of the spectacular, and as further proof of the American propensity to do a thing anyway when someone says, "It can't be done," two outstanding developments only need be cited; the Hamilton 1000-ton mechanical presses now turning out automobile turret-tops at the Grand Rapids plant of Fisher Body, and the Hydraulic Press Mfg. Co. 5000-ton capacity high speed hydraulic press for forming and punching airplane parts at the Santa Monica plant of Douglass Aircraft. Both these events were noted in detail in THE IRON AGE (Mar. 4, Aug. 12 and Sept. 16, 1937), but may be reviewed briefly here.

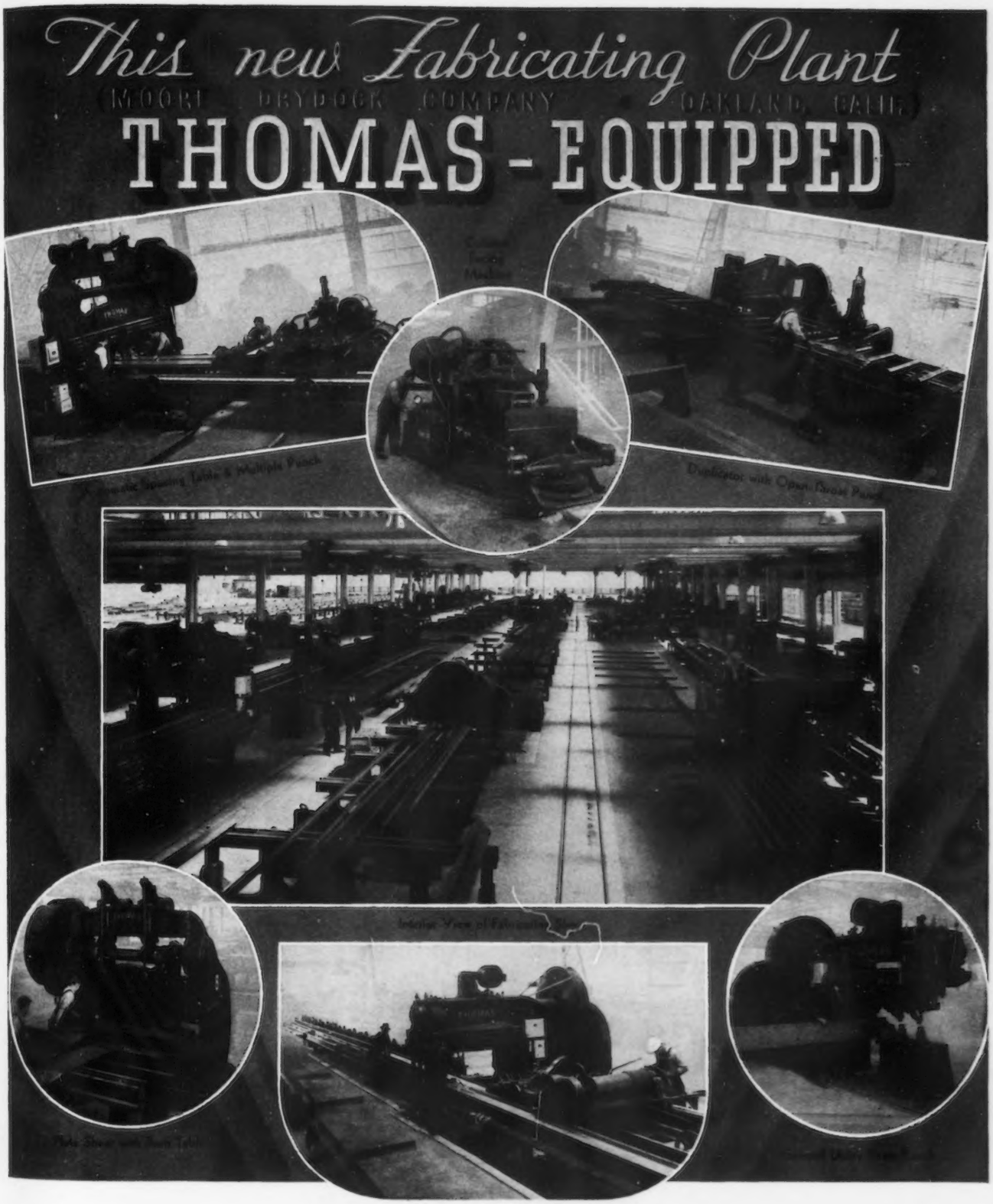
Big Presses

The Hamilton presses at Fisher Body are of the mechanical triple-acting type. A unique feature of the design is the location of the driving mechanism (clutch, brake, gearing, flywheel, motor, etc.) *below* the plant floor instead of on top of the press. Not only does this construction facili-

This new Fabricating Plant

MOORE DRYDOCK COMPANY OAKLAND, CALIF.

THOMAS-EQUIPPED



Beam Punch & Semi-Automatic Spacing Table

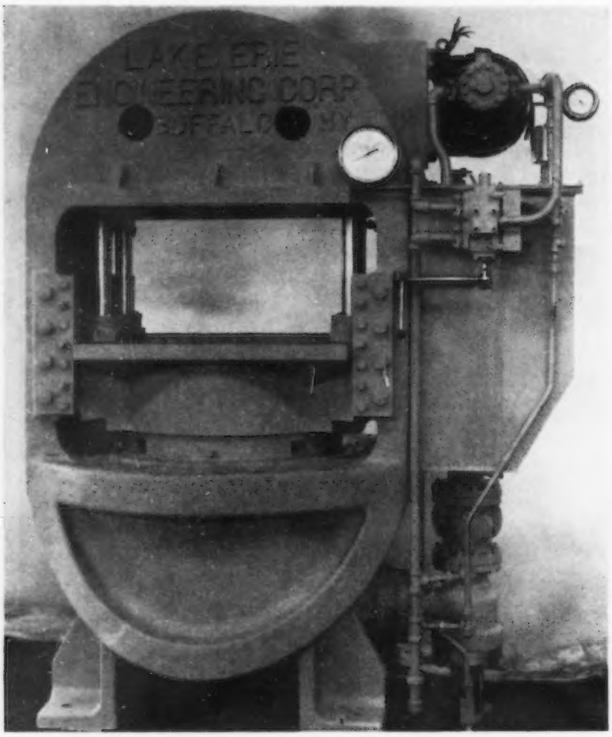
● With but few exceptions, every fabricating machine in this model new plant was supplied by THOMAS, a few of which are illustrated. Thomas manufactures presses, plate-shears, bending and straightening machines, multiple drills and punches, as well as other special equipment for shipyard use. ¶Consult Thomas for your needs.

THOMAS

MACHINE MANUFACTURING COMPANY

Name changed from Thomas Spacing Machine Co.

PITTSBURGH, PA.



AT LEFT

FIG. 1 — Lake Erie Engineering 1500-ton hydraulic press with solid cast steel continuous band frame, providing extreme rigidity of structure.

o o o

BELOW

FIG. 2 — Steelweld press brakes are outstanding examples of the use of welded steel construction of bed, side-housings and crown to form a unit structure.

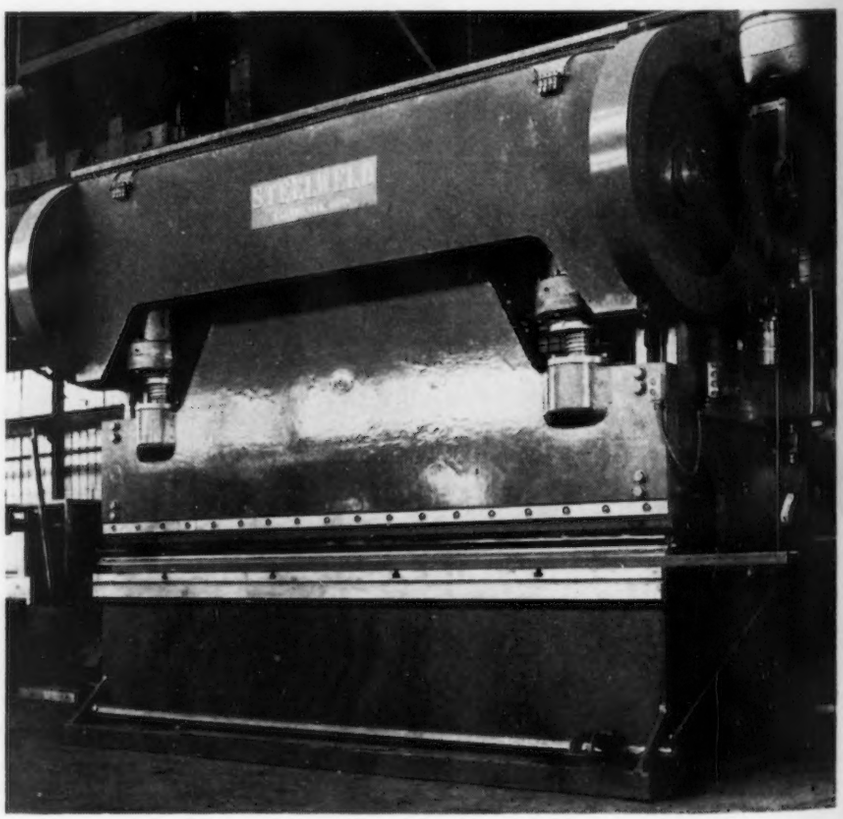
tate inspection, adjustment and maintenance, but it permits perfect symmetry of the press above the working floor. Due to this symmetry of design and the resulting lowering of the center of gravity, vibration is almost entirely eliminated, producing a marked improvement in the quality of the stampings and materially decreasing the noise of operation. On these presses the three die slides are tied together, two above and one below; that is, they are driven from a single, common clutch. Hence they cannot get out of time with relation to each other. Four push buttons control the entire operation, and the interlocking features of the control make it necessary for two men each to push two buttons simultaneously to start the press. With all four hands occupied with buttons, safety considerations are perfectly met.

The Hydraulic Press installation at Douglas Aircraft is said to be the largest high-speed hydraulic press in the world. The total pressing force of 10,000,000 lb. is exerted by a single ram 6 ft. in diameter, actuated by oil under a pressure of 2500 lb. per sq. in. from four large radial pumps of the variable-reversible delivery type, driven by two 150-hp. motors. With the object of securing interchangeability, flexibility and greater manufacturing economy in the fabrication of aluminum alloy aircraft parts, Douglas made a test of the possibilities of forming and punching several unrelated parts at a single setting through the initial installation of a 2000-ton capacity press two years ago. The experience gained resulted in the purchase of this 5000-ton unit, and over 3000 parts are now shaped in the two presses.

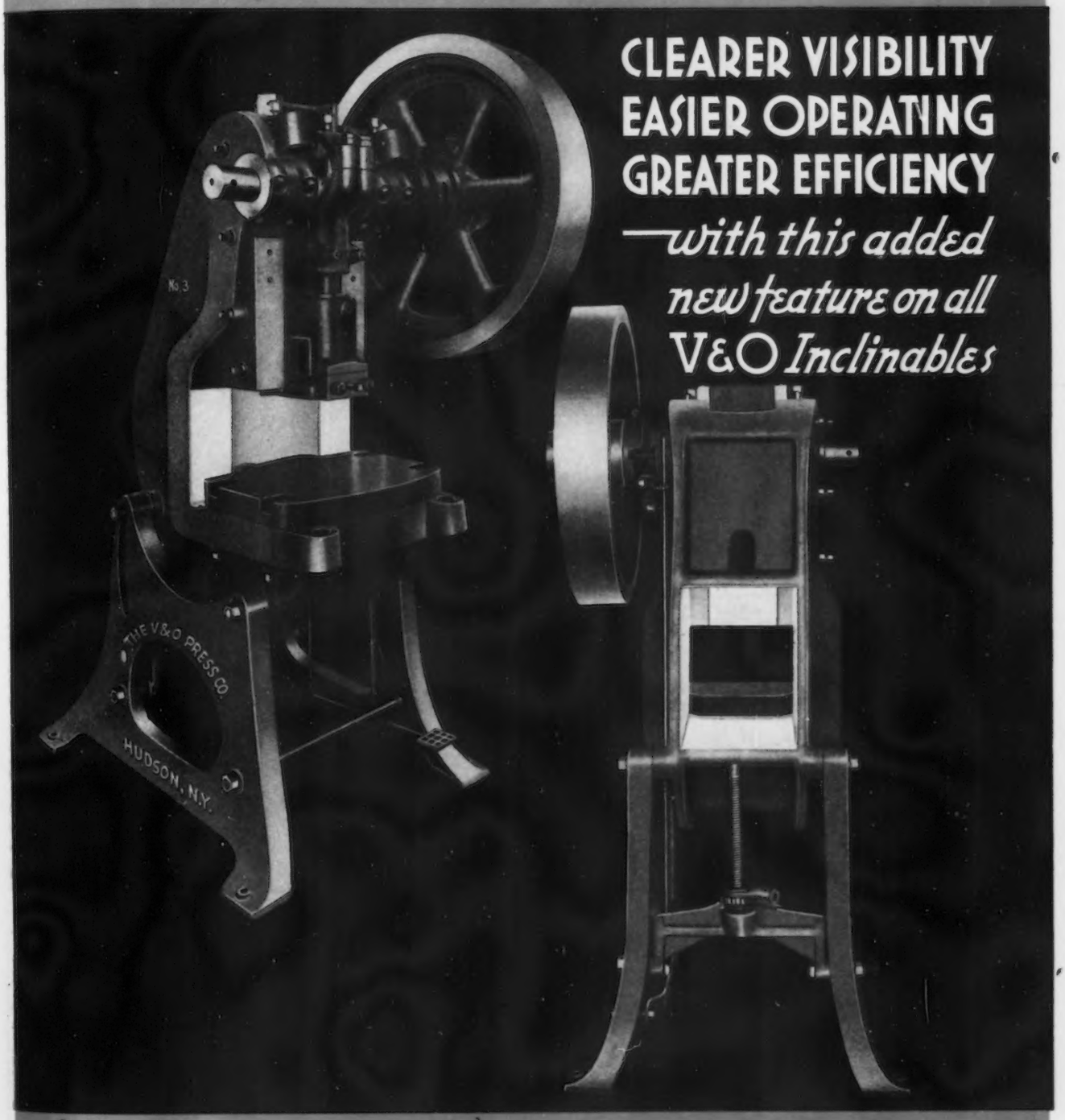
Integral Frame Construction

A number of equipment manufacturers have made extensive use of welded steel frames during the past year. This is particularly true of special presses designed for automatic operations; the exceptional strength and rigidity of scientifically designed welded steel frames resulting in the precision alinement necessary for high grade progressive-die operations. With greater precision of alinement has come increased speed of operation, necessitating a greater use of auxiliary equipment to aid completely automatic operation, such as automatically controlled power-driven stock reels. On the other hand, even in non-automatic equipment, welded steel frames have contributed to a greater rigidity of structure with less overall structural weight. As a consequence we find the "streamlined" press structure, of modern and pleasing appearance, gradually superseding the huge, cumbersome and ugly designs of a decade ago.

An extreme instance of the new ideas in welded frame construction is the Lukenweld design, described in detail in the issue of Oct. 21 by Everett Chapman, of Lukenweld.



The Press with the DAYLIGHT THROAT



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D. S. Mair Machinery Corp., Houston and Dallas, Texas.
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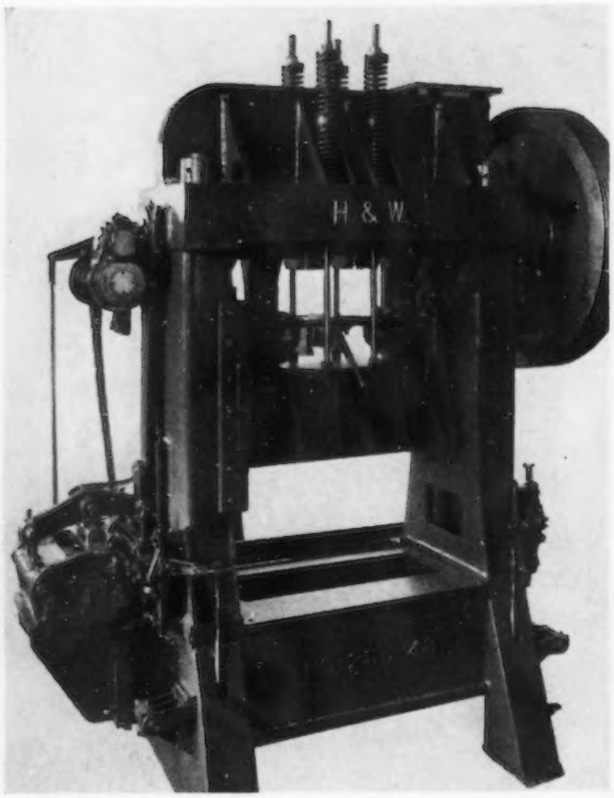


o o o

FIG. 3—A Henry & Wright progressive-die, high-production press with automatic feed. The frame is of welded steel construction for precision alinement of dies.

o o o

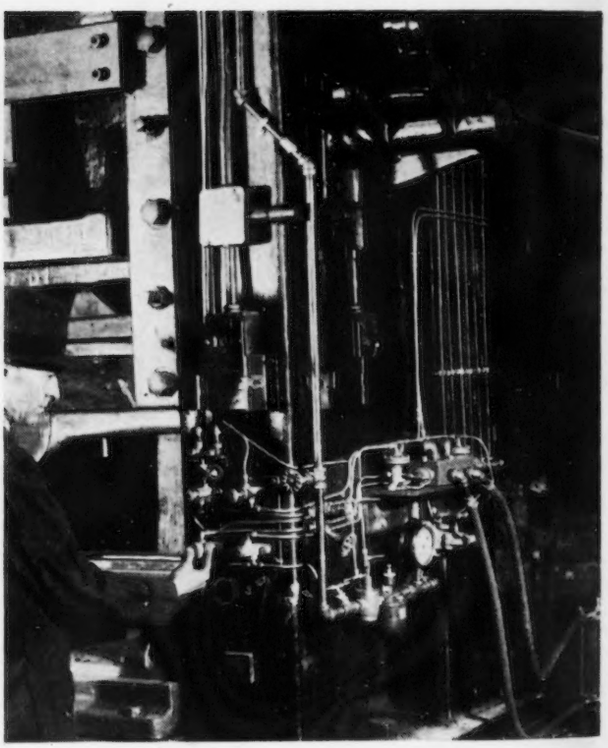
Oddly, the continuous band frame design in solid cast steel construction has been used with great success by Lake Erie Engineering Corp. As illustrated in Fig. 1, this high speed hydraulic press is of particular interest to users handling heavy tonnages requiring highly accurate platen alinement and travel. With a rated capacity of 1500 tons the unit is completely self-contained, and operates at 7½ strokes per min. at full tonnage, or 12 strokes per min. at somewhat reduced pressures. This press is in use for accurate embossing operations and is equipped with a push-back for breaking the molds, but other presses of this design, up to 2500 tons capacity and over, are

The principal feature of this design is the forming of the frame in one continuous, straight-sided oval band, of heavy, special quality welding steel plate, bent to shape, with other formed steel plates welded to the band to provide the base and supporting members. In one particular case, this design produced a frame weighing only 5380 lb. for a hydraulic press of 1350 tons capacity. It is claimed that this construction minimizes the curvilinear type of deflection inherent in the conventional type of press platens. Hydraulic presses of up to 3000 tons capacity have been built with this continuous band welded frame construction.

o o o

FIG. 4—The Tomkins-Johnson air-operated press control system, as installed on a heavy mechanical forming press. This control system is extremely simple.

o o o



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THE WAPAKONETA MACHINE COMPANY, Wapakoneta, Ohio

Manufacturers of Machine Knives for 47 years

in use for die sinking, grinding wheel forming and other similar operations.

Welded steel construction is now used by Colonial Broach Co. in its 50-ton capacity hydraulic presses for automotive assembly work, and Service Machine Co. has a new line of light-weight, deep-throat adjustable bed power presses having all steel welded frames and welded steel adjustable knee-beds.

Welded steel construction is, of course, a principal feature of Steelweld Machinery Co.'s press brakes. Fig. 2 shows a new model with a capacity of 10 ft. of ⅜ in. steel, or equivalent. C. J. Bath, president of the company says, "A press is just two legs of a nut-cracker. Whereas it is very easy to develop enormous tonnages by the action of an eccentric or crank, the problem of the press manufacturers has always been to make the frame sufficiently stable to resist deflection. . . . By making the bed an *integral* part of the side housings and of the crown (by means of welded construction) and machining them all together, we not only assured permanent alinement, but we made a structure the strength of which could be calculated as a single element rather than as an assemblage of bed, side housings and crown."

A Henry & Wright welded steel frame progressive-die press designed for high speed, high quality production is shown in Fig. 3. This welded construction results in exceptional frame rigidity, as required for precision alinement of the dies, yet is of lighter overall weight than would otherwise be required.

Controls

Two factors have been of major importance in recent control design; (1) sensitivity, and (2) safety. The control must respond quickly and accurately, but at the same time it must be so sturdy that the severe shocks of press operation will not derange it. The control must likewise include every desirable feature of safety necessary to protect the workmen and the equipment. This implies a degree of interlocking action which requires the workmen to be well out of any danger zones while the press is running, and which automatically stops the machine or relieves the pressure whenever operating conditions impose too severe a load on the mechanism. These two factors, of sensitivity and of safety, mark various advances made recently in press controls.

As examples, but three improved control systems need be cited. One

The Best Shear Blade You Can Buy Carries This Mark

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TRIPLE COMPRESSION
SCRAP BALERS

STYLE
100 TC
(100 x 51 x 36)
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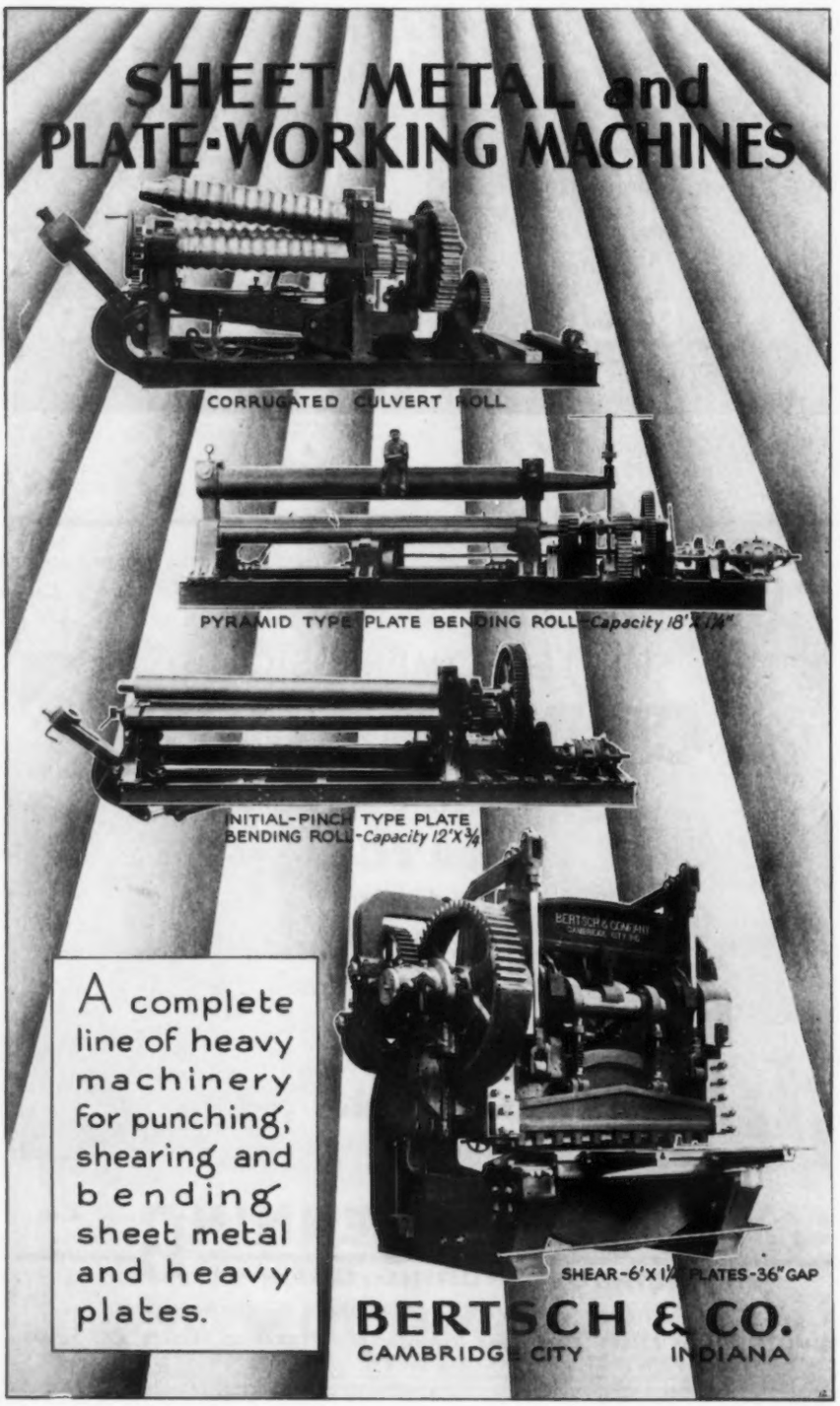
in all sizes

GALLAND-HENNING
MANUFACTURING COMPANY
2724 S. 31st Street Milwaukee, Wisconsin
COMPLETE LINE OF BALERS: Electric and Hydraulic, also HYDRAULIC PRESSES AND PUMPS

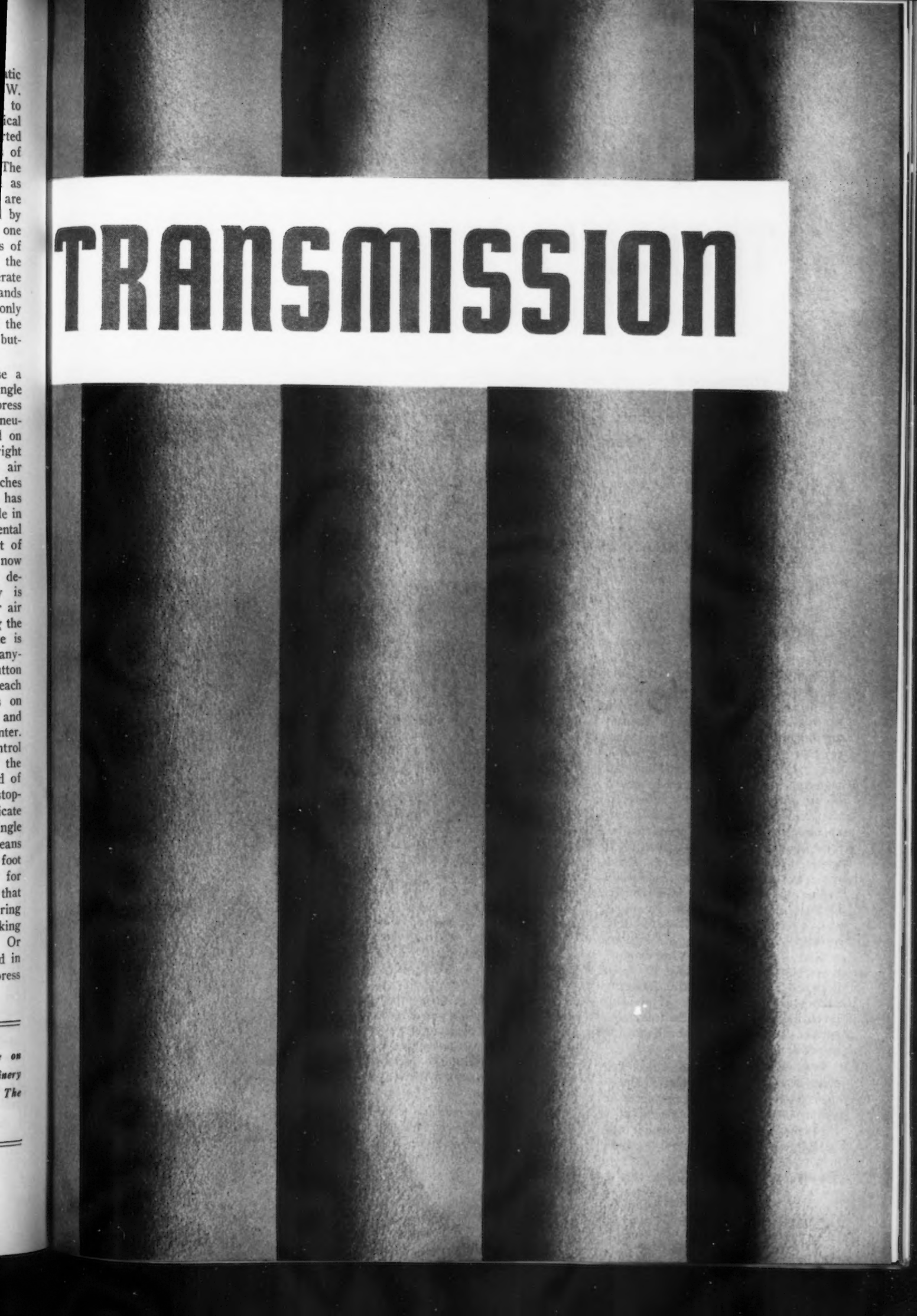
is the new Tomkins-Johnson air-operated remote control valve system, shown installed in Fig 4 on a large mechanical press. It is claimed that this system simplifies press control from several points of view. 1—Appreciably less control equipment is required for the same installation; 2—more sensitive reactions permit a more efficient handling of the press; 3—less power is needed to operate the clutch; 4—absolute safety is provided for the operators; 5—the very nature of the control medium (air) provides the highest degree of safety for the machine itself. The various starting buttons are piped in series, providing a positive interlock all through the press operation cycle. These systems have been furnished as standard equipment on various presses made by such typical manufacturers as E. W. Bliss Co., Charles F. Elms Engineering Co., Allsteel Press Co., and Dreis & Krumpp Mfg. Co.


SHEET METAL and PLATE-WORKING MACHINES
CORRUGATED CULVERT ROLL
PYRAMID TYPE PLATE BENDING ROLL—Capacity 18'X1/4"
INITIAL-PINCH TYPE PLATE BENDING ROLL—Capacity 12'X3/4"
A complete line of heavy machinery for punching, shearing and bending sheet metal and heavy plates.
SHEAR-6'X1/4" PLATES-36" GAP
BERTSCH & CO.
CAMBRIDGE CITY INDIANA

A second example is an automatic electric control system used by E. W. Bliss Co. This control is applied to a Toledo type, 4-point mechanical press in which the action is imparted through the gears to four points of the slide, one at each corner. The control buttons are here known as "palm" buttons, because they are made large enough to be pushed by the palm of the hand instead of one finger. The interlocking features of this system require that both of the two men generally needed to operate such a machine must keep both hands on their respective buttons, not only to start the press, but throughout the entire operating cycle. Any one button, released, will stop the press.

The third example is likewise a Bliss development. It is a single crank, double-action drawing press equipped with the new Bliss pneumatic clutch, which is supported on the bracket mounted on the right hand housing. Direct-action air operation of press friction clutches is obviously simple in theory, but has not heretofore been quite so simple in practice. Many years of experimental work preceded the announcement of this pneumatic clutch; but as now made available, it is absolutely dependable, and operating safety is maximum. Cutting off power or air supply can only result in stopping the press. The power of the brake is such that stopping is immediate, anywhere in the stroke. Push button controls are so arranged that each operator must keep both hands on buttons until the die has closed and the press has passed bottom center. A selector at the top of the control panel may be set by a turn of the wrist to give a choice as desired of (1) continuous operation, with stopping at any time, (2) very delicate inching, for die setting, (3) single stroke top-stop operation by means of a brief pressure on a hand or foot button, or (4) safety operation for one or more operators requiring that both hands be kept on buttons during the down stroke half or working quarter of each stroke as desired. Or the control handle may be locked in the "off" position so that the press cannot be operated at all.

THE conclusion of this article on Presses and Sheet Metal Machinery will appear in a subsequent issue of The Iron Age.


TRANSMISSION

POWER TRANSMISSION

Rising costs of production, in 1937, stimulated study and application of power transmission modernization as a profitable means of cost reduction.

o o o

By FRANCIS JURASCHEK
Consulting Editor, THE IRON AGE

o o o

DURING the past year the subject of the application of power to the machines of industry has been more in the limelight than at any other time in the past. It is natural that, in a period of rising costs, more attention should be paid to all matters which directly affect the costs of production. In the past, however, the chief item of interest in this connection has always been the improvement of production machinery. It would be foolish to say that we have come to the ultimate end of the road in this matter, for much still remains to be done, and inventive genius is still at work. It is true, however, that a temporary pause is quite evident, and for a very simple reason. Production equipment of all kinds has been designed and built with operating characteristics capable of yielding much higher efficiencies than management as a whole has learned how to use effectively.

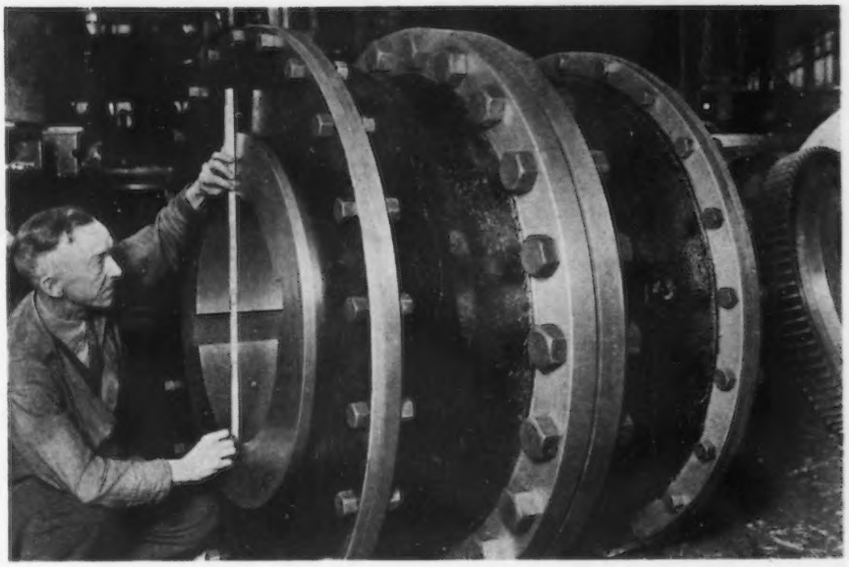
It is well known, for instance, that much of the modern production equipment lately installed in manufacturing plants is capable of operating at a higher load-factor and for longer sustained periods than its actual use indicates. The inherent efficiencies of such machines are *not* being used to the fullest possible extent, because they have not been completely coordinated in the whole production scheme. The fault is, generally speaking, management's. This statement may be made clear by a consideration of two factors which underlie the whole problem of production economy. The first and most important is materials handling, or the problem of coordinating the flow of materials through the plant in such a way as to insure that the production equipment shall have the stuff on which it is to work, *where* it is needed, *when* it is needed, *dependably*. This subject is reviewed briefly elsewhere in this issue. The second factor, however, is not very much less important, but is as yet not so well understood. It involves the whole matter of applying power to all the moving equipment in a plant in such a way as to insure the continuous flow of production with the least use of power commensurate with the results to be achieved.

Industrial management is learning that it is not sufficient merely to buy modern machinery in order to step up production and to decrease production costs. The new equipment must be keyed into an organized scheme of production flow, and must be operated by an *appropriate* application of power, to achieve the desired results. Hence, power application engineering has, at long last, come into its own estate, as a vital factor in production economy.

Directly reflecting the increased in-

RELIANCE Electric fully-inclosed fan-cooled d.c. motor equipped with glass peepholes to facilitate inspection of the interior.

terest of management in this subject, the industrial publications of the country have been devoting an ever-increasing amount of space to technical expositions of how to apply power to machinery efficiently and economically. During the past year more informative editorial material has been published on this subject than in many years of the past together. And the evidence that such editorial policies have been timely and effective is found in (1) the large volume of comment and suggestion from readers who are actually out in the shops facing definite problems, and (2) the increased volume of power transmission equipment sold during the past year. This latter statement is substantiated by a recently completed IRON AGE survey covering the 1937 business of the principal manufacturers of industrial power transmission equipment in the United States.



POOLE FOUNDRY & MACHINE mill-type gear-engagement flexible coupling for a 22-in. shaft, with new oil-tight end plate to prevent oil leakage.

The Iron Age Survey

This survey included 152 transmission equipment manufacturers. Twenty-four of these make electrical motors or controls, or eqipment of direct electrical operation. The rest make mechanical power tranmission equipment ranging from coupling and clutches to belting, shafting and bearings. Individual data, while in a majority of instances marked "confidential" were freely tendered, and, checked against field observations and a study of known information, revealed a surprising volume of business during 1937. From tabulated returns of this survey, these facts have been deduced:

STEARNS Magnetic high-duty combination magnetic clutch-brake unit, 24-in. diameter, for remote control of rubber mill operation.

Electric motors and controls for strictly industrial applications were in extraordinary demand; sales for 1937 averaging about 35 per cent more than during 1936, and approaching closely the best dollar volume figures for the years prior to 1930.

Mechanical transmission equipment of the positive type (couplings, chain drives and gear drives) averaged about 30 per cent better than during 1936, and on the whole established record figures for dollar volume sales.

Mechanical transmission equipment of the resilient types (friction drives of all types, hydraulic and pneumatic drives) averaged about 20 per cent better sales in 1937 than in 1936, but on the whole were still far behind the best dollar volume figures for the years prior to 1930. This was due largely to the low comparative figures for friction drives. Hydraulic drives soared ahead of all previous figures. This field is comparatively new and is breaking ground every day on different applications, a feature of the fields invaded being both machine tool, and process equipment.

As was to have been expected, the modern group drive idea has gained ground, especially in the textile industry. One equipment manufacturer reports, "While we have made no outstanding improvement in our line of power transmission equipment during the past year, we are very gratified to report that there has been a very marked tendency of industry to accept the group drive as against the individual motor drive. Exhaustive researches have proved conclusively that the group drive is more economical and efficient than the individual motor drive for certain general industrial purposes, and the installation cost, as well as the upkeep and total power consumption; is considerably less by the group drive method." There is no doubt but that a considerable change of opinion has taken place since the modern group drive idea was first publicized about 1930. Careful study, however, leads the writer to believe that for every industrial machine hooked up to a modern group drive set-up during 1937, about five machines were hooked up to individual motor drive. Considering that the logical ratio of possible applications to all industrial machinery is about 3 to

MOTORS
Can Act Lazy, Too

YOU'VE probably seen fellows like this—fellows who drop everything at the slighest excuse and take a nap.

Perhaps you've had motors in your shop that had the same bad habit—motors that would go out of service every time there was an overload or a voltage fluctuation.

But the motor is unlike the man we've shown here—for in nine cases out of ten it isn't the motor's fault that it acts lazy—it's the fault of incorrect control.

Correct control protects the motor against unusual operating conditions, but prevents laziness by keeping the motor operating unless it is seriously overheated or overloaded.

Why not find out more about the G-E control with isothermic overload protection—protection that prevents motor laziness? General Electric, Schenectady, N. Y.

What Is Isothermic Overload Protection?

Ordinarily, the only function expected of a motor starter is to start and to stop the motor for which it is responsible.

But it must do more than that—whenever the motor is running, it must exercise vigilance to make sure that operating conditions that may develop do not harm the motor.

In performing this function, the G-E isothermic overload relays exercise discretion—they don't shut down the motor at the first indication of motor heating. Instead, they wait until the motor *needs* to be shut down to protect its windings and other vital parts.

GENERAL ELECTRIC

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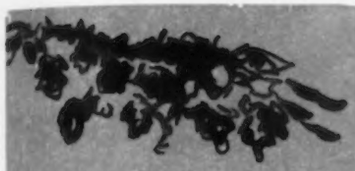

ALL THESE G-E CONTROLS GIVE ISOTHERMIC PROTECTION

The Manual Starters —for control, by a toggle switch, of motors rated up to 5 hp.

CR7006 Magnetic Switches for full-voltage starting of induction motors from a push button or other control

CR-1034 Reduced-voltage Starters for manual or magnetic starting of induction motors. Voltage reduced by means of an autotransformer

The Complete Oil-immersed Control Line —providing starters beneath oil for all of the above duties. Even the isothermic overload relay is oil-immersed

MOTOR CONTROLS

1 in favor of individual motor drive, this 5 to 1 ratio during 1937 indicates a most amazing growth of the modern group drive idea.

New Equipment

Oddly, comparatively little new industrial power transmission equipment was announced during 1937. In a majority of cases manufacturers were content to make minor improvements in existing equipment, or to "let well enough alone.' This undoubtedly reflected the needs for a consolidation of the gains of the somewhat feverish efforts of the past five years on the designing boards and in the experimental laboratories. Some of the most noteworthy of the actual new developments are reviewed briefly below.

Electric Motors—Reliance Electric & Engineering ventures the opinion that "there is no question but that the motor is becoming more and more a part of the production unit, and not merely the power unit. In the first sales of electric motors the entire thought was given to the method of transmitting power. However, in the modern development of various types of alternating current motors giving multi-speed characteristics, quick reversing and stopping, of gear-motors, brake-motors, and also with the advances made in getting adjustable speeds economically from direct current equipment, motors are now being applied to machines from a production standpoint, with the use of power really a secondary consideration. It has actually been found that, in most production machines, the power consumed as compared with the production value of the machine itself was so little, that getting the right drive in the right place, with the proper motor applied, was far more important. However, on certain machines such as pumps, large fans, and machines of that type, the power consumption is a real item of cost and must be considered very fully in the application of motors." Reliance has brought out a new line of "permissible" motors for use in gaseous atmospheres, a new line of squirrel cage induction motors with magnetic disk brake mounted integrally, and a new fully inclosed, self-ventilated d. c. motor with glass peep-holes to facilitate constant inspection of the interior workings.

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T. B. WOOD'S Universal Giant flexible type friction cut-off coupling, with friction disks driven by steel pins in bronze bearings cushioned in live rubber.

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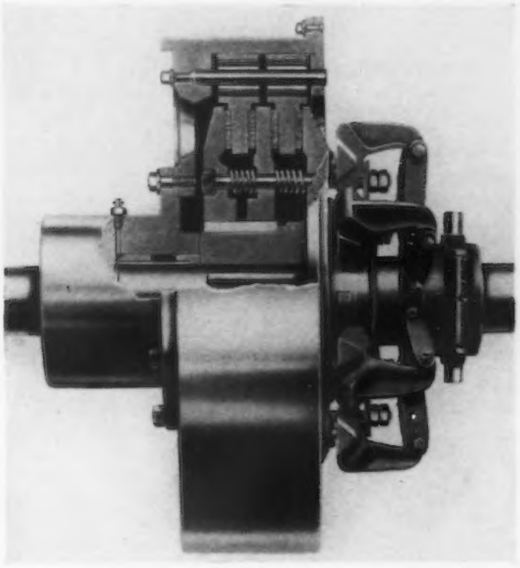
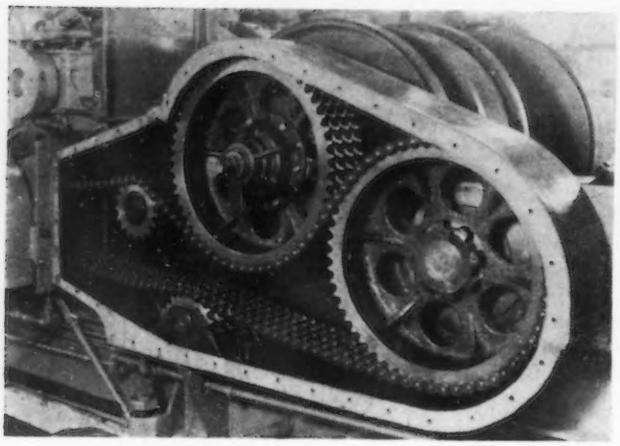


Allis-Chalmers has added to its line of special textile motors a "Quick-Clean" squirrel cage motor with interchangeable stator and indestructible rotor, so designed as to be taken apart quickly for cleaning. The seal-clad rotor presents a smooth, hard surface to which dust or lint cannot adhere. All working parts are positively dust-sealed. This motor is especially applicable for cotton mill service.

Louis Allis has extended its line of arbor motors, and shaftless motors with both frame and rolled shells, for machine tool applications.

Illustrative of the range and variety of motors demanded by individual manufacturing plants today, Fairbanks Morse equipped what is claimed to be the world's largest bleached sulphite pulp mill with 350 motors totaling over 10,000 hp. with some 18 different types of motors ranging from vertical units direct connected to the bleach cells to horizontal splash-proof



WHITNEY Chain quadruple strand roller chain driving three shafts, with take-up, on a diesel-engined Berger yarder.

motors V-belt connected to flat screens.

Electrical Controls, etc. — Electric Controller & Mfg. Co. brought out a complete line of very compact steel clad motor control panels, a new automatic discharge magnet controller for the quick release of loads handled by a lifting magnet, and a new automatic power factor regulator which maintains the power factor of a plant between pre-determined limits. Cutler-Hammer has likewise developed a new automatic magnet control which instantly de-energizes a lifting magnet by means of a flash of reverse current.

Miscellaneous Electrical Equipment —Stearns Magnetic Mfg. Co. has announced a new electrically operated clutch and a combination clutch-brake unit; the latter being a further development of the former device, and both constituting improvements on former Stearns mechanisms. Magnetic multiple disk clutches offer the advantages of remote control for clutching operations; the magnetic brake when added to the clutch brings the free shaft to a quick stop, automatically.

Mechanical Equipment—Positive

Couplings—Several new flexible couplings have been developed within the past year. Falk has greatly improved its "Steelflex' spring grid type coupling. Link-Belt has brought out the "R.C.B." coupling in which a specially designed roller chain made in two pieces enables each sprocket to have its own set of rollers instead of a single set for both sprockets as heretofore.

Bartlett Hayward Division of Koppers has developed huge new Fast type couplings on the gear-engagement principle, especially for heavy steel mill service. Poole Foundry & Machine has improved its mill type flexible coupling of somewhat similar design by the addition of an oil-tight end plate to prevent oil leakage.

A new Lovejoy flexible coupling, type WQ, of the interlocking jaw-tooth type with a resilient cushion between the teeth, has one set of jaws made in the form of a removable ring, which is held in place and driven by 3, 5, 7, or 9 hexagonal headed, alloy steel, cap screws, operating from one jaw body. This removable ring makes it possible to make machine adjustments without removing the coupling itself. Three types of cushion material are available; metaflex, a high grade, long-wearing brake-lining material, for heavy shock load service; oak-tanned leather for sustained load service or where misalinement is serious; and multiflex, a rubber duck fabric vulcanized under pressure, for loads which fluctuate considerably and where maximum resiliency is important.

The Rybeck improved heavy-duty flexible coupling made by T. L. Smith Co. is a full-floating, semi-universal joint type, of laminated spring-and-pin design, which takes care of excessive offset between shafts as well as severe angular misalinement, due to the wide spacing of parts where the torque sleeves engage the loads.

Clutches—T. B. Wood's Sons Co. has developed a Universal Giant flexible type friction cut-off coupling, as illustrated. The friction disks are driven by steel pins cushioned by rubber bushings, with self-lubricating bronze bushings embedded in the live rubber. This device is especially adapted for use on internal combustion engine drives, or wherever heavy impact is encountered on either end. Sizes available now accommodate from 15 to 240 hp. at 100 r.p.m.

Conway Clutch Co. has a new full-floating expansion clutch in which the friction band is centered when idle, and is full-floating when engaged. The design is very simple, parts being completely interchangeable, and of rugged construction.

Medart is developing a new disk-type friction clutch which should be ready for the market in January.

Two "free-wheeling" clutches were

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TEN BIG POINTS

1 Belt slippage eliminated.
2 Belt sealed to pulley by Vacuum Cups.
3 Belt "slap" eliminated.
4 Tight stretching of belts unnecessary.
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8 No power loss on heavy shock loads.
9 No pulley maintenance expense.
10 Vacuum Cup Pulleys never wear out.

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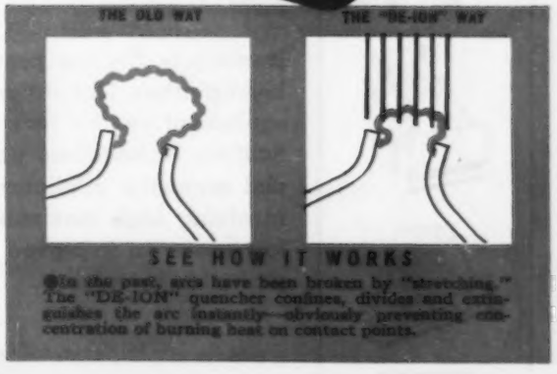
THE OLD WAY
THE "DE-ION" WAY
SEE HOW IT WORKS
●In the past, arcs have been broken by "stretching." The "DE-ION" quencher confines, divides and extinguishes the arc instantly—obviously preventing concentration of burning heat on contact points.

BUT "DE-ION" ALSO MEANS . . . .

- **LESS UPKEEP**
- **COMPACT DESIGN**
- **LONG LIFE**

Every one of these features has an important meaning to plant owners, machine operators, maintenance men and machine designers. You get them all in Westinghouse "De-ion" Linestarters.

Westinghouse "DE-ION" LINESTARTERS

placed on the market last year by Morse Chain and by Hilliard Corp. Free-wheeling or over-running clutches are especially useful for dual drives when connected from two separate power sources, or for two-speed drives and other similar applications on a single machine. With such units, as long as the power unit drives the load the clutch remains engaged, but if, for any reason the driver tends to run slower than the driven shaft, the clutch releases, or over-runs. The Morse equipment is known as a "high torque indexing and free-wheeling" clutch, and has been applied to many heavily powered installations. The Hilliard Automatic Over-running clutch is more recent, but has been applied successfully to printing presses, railway brake shoe testing machines, and strip metal slitters.

The Morse Pullmore multiple disk clutch has been improved in detail, and is finding wide application in machine tool work because of its small diameter, high pulling capacity and long life.

The new Dodge Loom Drive for textile weaving machines is similar to the Power Transmission Council's Energy Drive. It is claimed that the clutch is of superior design and that the flywheel type pulley has been so constructed as to simplify the work of installation. Porous capillary oiling bronze bearings and a long-wearing molded asbestos friction material reduce maintenance care to a minimum.

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MAGNETIC EQUIPMENT

WHATEVER YOUR NEED
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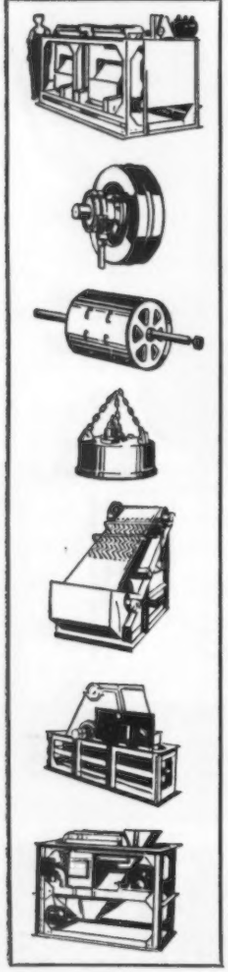

Separators — Clutches
Drums — Brakes
Rolls — Special Magnets

Thirty-five years of practical pioneering magnetic engineering experience is back of the Stearns High Duty trade mark.

Constant development and research by Stearns engineers, together with extensive laboratory facilities, has been responsible for much of the present day wide-spread utilization of magnetic equipment.

Investigate Stearns products. Consult magnetic headquarters. Avail yourself of Stearns magnetic equipment whether for separation, protection, purification, reclamation, power transmission or special magnetic appliances. You can be sure of receiving high maximum operating efficiency at low costs, an improved product with a definitely profitable investment.

Write for our bulletin, "The House of Magnetic Magic."

STEARNS MAGNETIC MFG. CO.
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635 S. 28th Street — Milwaukee, Wis.

Chain Drives Increase

Chain Drives—One evidence of the outstanding increase in the use of chain drives is the fact that Chain Belt has found it necessary during the past year to build a new machine shop at its West Milwaukee plant, 292 ft. long by 152 ft. wide, with five longitudinal bays and one large transverse bay. A new Chain Belt development of the past year is a coiled bushing with beveled ends, blanked from strip metal, with curled ends meeting squarely and forming a perfectly round bushing when pressed into the roller links. It is claimed that this bushing produces a smoother running and longer lasting roller chain. Three new types of chain have been developed by Chain Belt for oil drilling rigs, from alloy steels, with parts highly finished for closer tolerances, smoother operation, greater dependability and longer life. Improvements in the heat treating of drive chains have been made by Chain Belt through the use of the continuous heat-treating furnace.

Morse Chain has developed what is known as "Bar-flex" silent chain, for use where space limitations and unusual loads prevail. A special type of sprocket is required for its use, and applications as yet are limited to designs approved by the Morse engineering department. It is claimed that the tensile strength of this chain is higher than that of any other type of silent chain, being 15,000 lb. times the pitch, per inch of chain width. Another Morse development is the No. 3480 type, a silent chain with compensating spring joint. The seat pin is drawn in two pieces. The section which fits into the slot of the link is slightly curved. When the chain wears, the spring of this curved piece takes up the slack. Thirty-seven of these chains are in use on practically vertical drives on ink drums of printing presses in a large newspaper plant, replacing twice the number of gears. The resulting advantages include extreme quietness of operation, elimination of vibration,

This is what a MACHINE TOOL MOTOR Must do !

Precision is the key word in practically all machine-tool operations — because it definitely involves the elements of production and cost control.

Therefore, a machine-tool motor must be sufficiently free from vibration to assure maximum precision — otherwise spoilage or production delays will result. . . . .

Century Type SC Squirrel Cage Polyphase Induction Motors are designed to assure you all the benefits of precision . . . They are used as standard equipment on "standard-package" grinders, sold by some of the most prominent manufacturers in the country.

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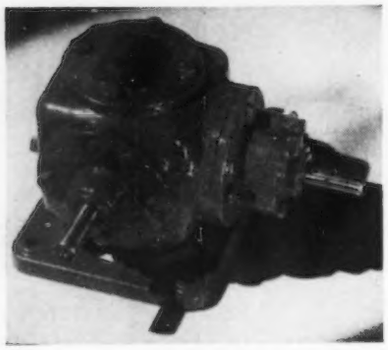
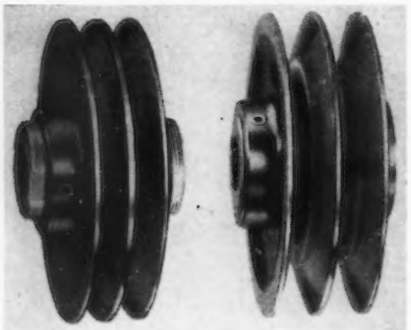
SIZES UP TO 600 Century MOTORS HORSE POWER

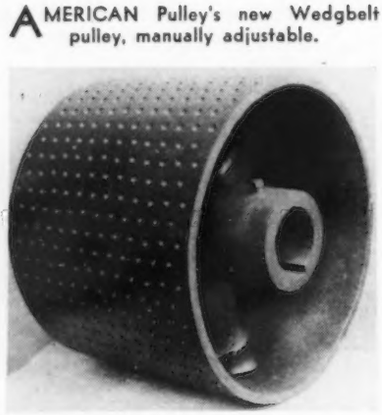
MESTA Machine gear drive in a merchant mill, transmitting 4000 hp.



BOSTON GEAR WORKS spiral miter gear box for right angled drives, carries the driven shaft horizontally from any side, or vertically from top or bottom.



AMERICAN Pulley's new Wedgbelt pulley, manually adjustable.



VACUUM Cup Metal Pulley, 24-in. diameter by 18-in. face. Unusually economical operating figures have been obtained by large industrial users.

and a large reduction in material and maintenance costs.

Whitney Chain & Mfg. has an improved roller chain, an illustration of which is shown driving three separate shafts, with a chain take-up, on a diesel engined Berger yarder. Baldwin-Duckworth has introduced several design improvements in roller chain, and Diamond Chain & Mfg. has a new type of chain sprocket, and a ⅝-in. pitch finished steel roller chain in single and multiple strands which is claimed to be even more quiet in operation than many silent chains.

Gear Drives — Farrel-Birmingham class R double helical gear reducer units of the Sykes continuous tooth herringbone type are now available in a wide range of sizes and capacities. These units are especially adapted for repeated peak load service in heavy industries, such as cement mills and steel plants. A complete catalogue is now ready for distribution.

Mesta Machine does little business in the power transmission field except in connection with its own steel mill equipment. That is, in itself, however, rather a large order. As illustrating the 1937 developments of this company, a photograph is reproduced showing a 4000 hp. Mesta gear drive in a merchant mill.

Boston Gear Works has a new spiral miter gear box which provides an efficient and compact means of transmitting motion at right angles. This unit is equipped with case-hardened steel spiral miter gears, with the shafts mounted in ball bearings. Cases are oil-tight, as the gears run in continuous bath of oil. The box can be furnished with the driven shaft projecting horizontally from any side or vertically from the top or bottom. Mounting can be arranged on the floor, on a pedestal, on a side wall, or on the ceiling. The four sizes available range, at 1200 r.p.m., ¾, 2, 5 and 12-hp. capacity.

Continental Diamond Fibre Co. has a molded plastic sprocket coupling, and makes silent gears from the same molded plastic, known as "Celeron." This new compound appears to be a worthy addition to the various synthetic silent gear materials now on the market, and is adaptable to a wide variety of uses.

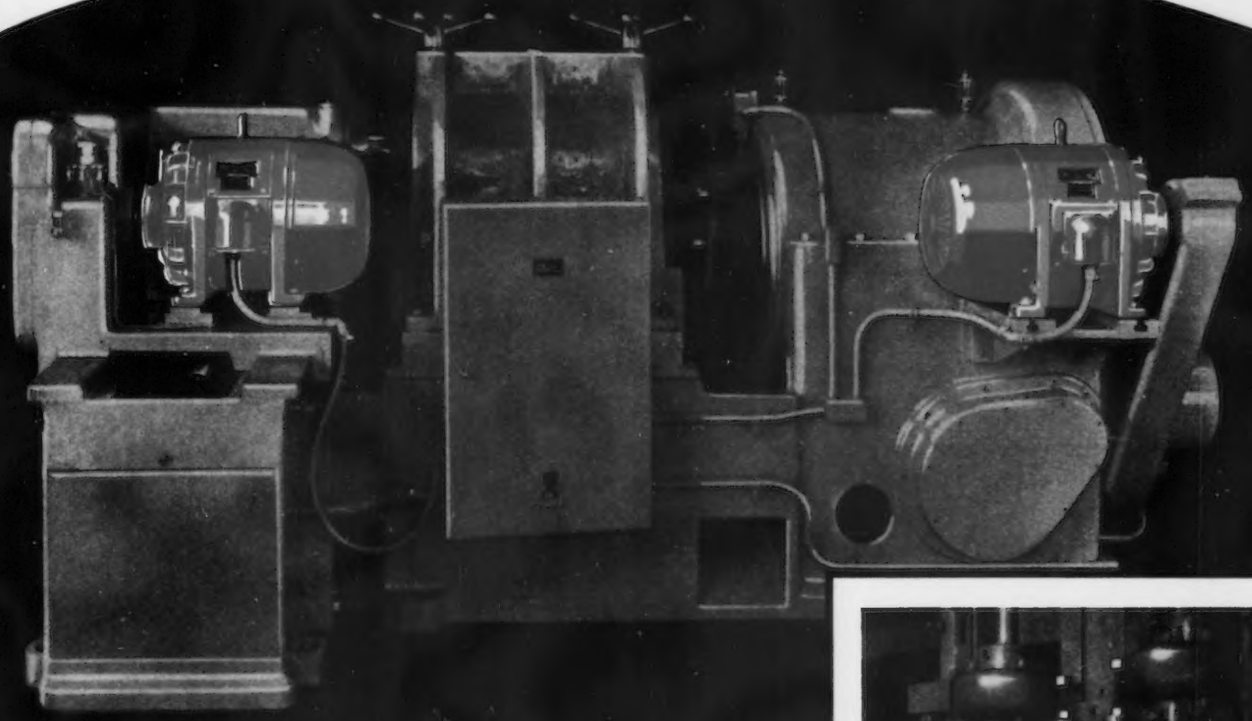
Variable Speed Transmissions— New Departure brought out a fractional horsepower Transitorq, type DT¼, which embodies the principal features of the larger units with the exception of preselection of speeds and automatic return to low-speed starting position. A speed range ratio up to 10 to 1 is available, giving, with a standard 1800 r.p.m. motor, a range from 560 to 5600 r.p.m.

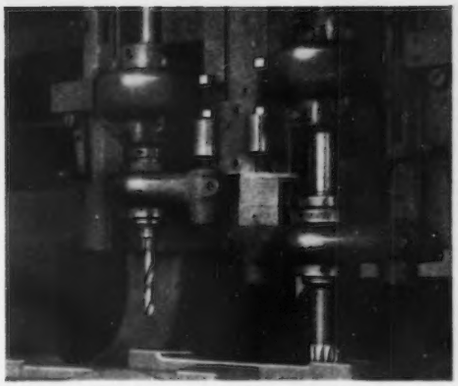
Reeves has an improved vari-speed motor pulley with a countershaft, the whole unit designed for unusual speed reduction or increased requirements. A cog-type belt runs from the usual adjustable disk motor pulley to a large pulley on the countershaft. The drive to the driven machine may be from a straight-faced pulley, chain sprocket, gear pinion, or V-belt sheave likewise mounted on the countershaft. More recently, Reeves has announced a new differential for use with variable speed transmission equipment, as illustrated, similar in principle to a motor-car differential. It is used in such automatic speed control operations as the synchronization of two or more machines, or parts of machines, maintenance of uniform peripheral winding or unwinding speeds on reels, etc. Gears of 1 to 1 ratio drive between shaft 1 and the differential gearing, while between the differential gearing and shaft 3 there is a 1 to 1 chain drive. For automatic control service, shafts 1 and 3 are connected to the driven shafts, while shaft 2 is connected to the speed-changing screw of a Reeves variable speed transmission unit. When shafts 1 and 3 are driven in the same direction at the same rate of speed, shaft 2 remains still. When the speed of either driven shaft varies from the other, this variation is transmitted to shaft 2, which speeds up or slows down the transmission unit until synchronization is restored.

Mechanical Transmission — Resilient

Belting — The Graton & Knight traveling belt-testing laboratory is undoubtedly the finest educational force ever developed to take the story of

INDUSTRY TURNS TO DELCO



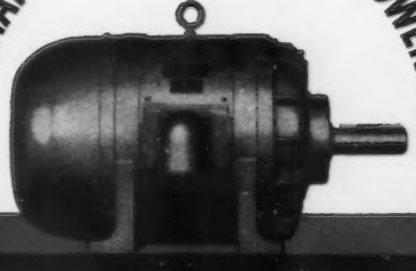


Each end of the rotor and shaft of a Delco motor is balanced independently. Two light beams traveling over a chart reveal the compensation required, and the exact point at which it must be applied. Then the complete rotating assembly is checked again. The perfect balance thus attained contributes to the satisfactory performance of Delco-powered machines. Specify Delco Motors on your equipment.

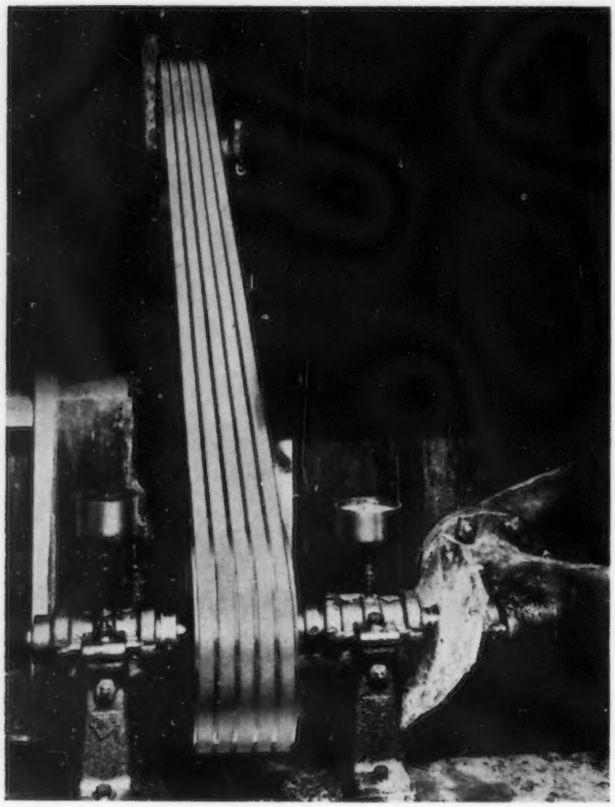
BUILT BY INDUSTRY FOR INDUSTRY

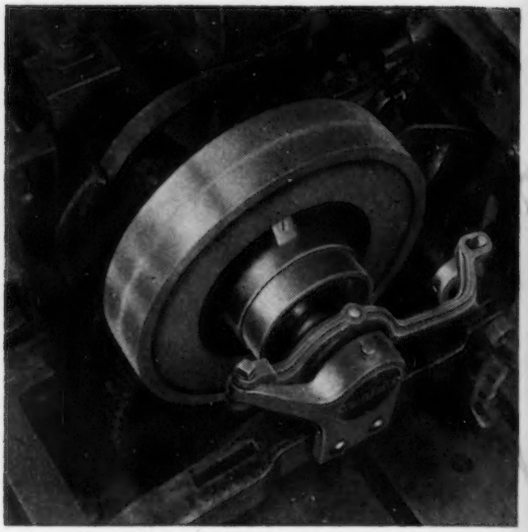
Close association with industry makes it possible for Delco to build motors from the point of view of the plant engineers who use them. These men, controlling factory operations in many parts of the country, conferred with Delco on the problems of industrial power ... problems of torque, balance and application. Each specified the qualities which, in his own mind, made up the "ideal motor." Then Delco engineers set to work to design a motor which would answer all demands. As a result, Delco motors are especially suited for industrial applications—because they are "built by industry for industry." Write for catalog. Delco Products Division, General Motors Corporation, Dayton, Ohio.

PERFORMANCE DEPENDS ON THE POWER PLANT



DELCO MOTORS





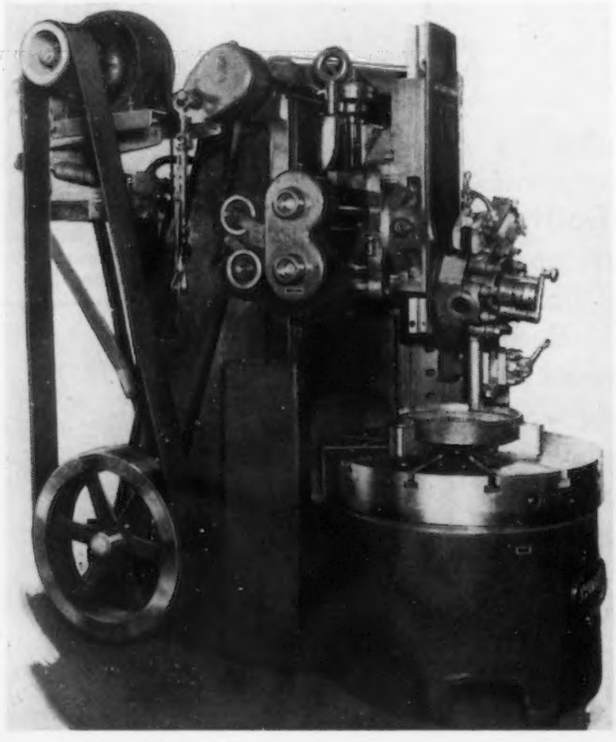
THE new Dodge Loom Drive is similar in principle to Power Transmission Council's Energy Drive.

o o o

THE new Dayton Rubber oil-proof V cog-belt, developed from a synthetic rubber compound for use where excessive oil conditions predominate.

belting efficiency directly into the plants of industry. As mentioned recently in these columns, this traveling laboratory is now on tour through the deep South, having already visited over half a hundred large industrial plants in New England, where the plant engineers have had the opportunity of testing their own belting under controlled conditions simulating actual production operations in their own plants.

Smyth-Despard reports the recent replacement of a 48-in., 3-ply leather belt over 100 ft. long on a main drive which has been transmitting through a similar belt 1000 hp. steadily for the past 17 years. At this rate the cost



ROCKWOOD vertical drive pivoted motor base, mounting a 20 hp. motor on a 42-in. boring mill. Note the simple steel bracket used to hold the motor base.

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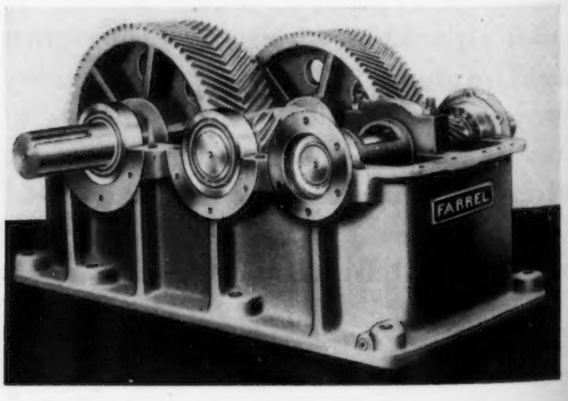
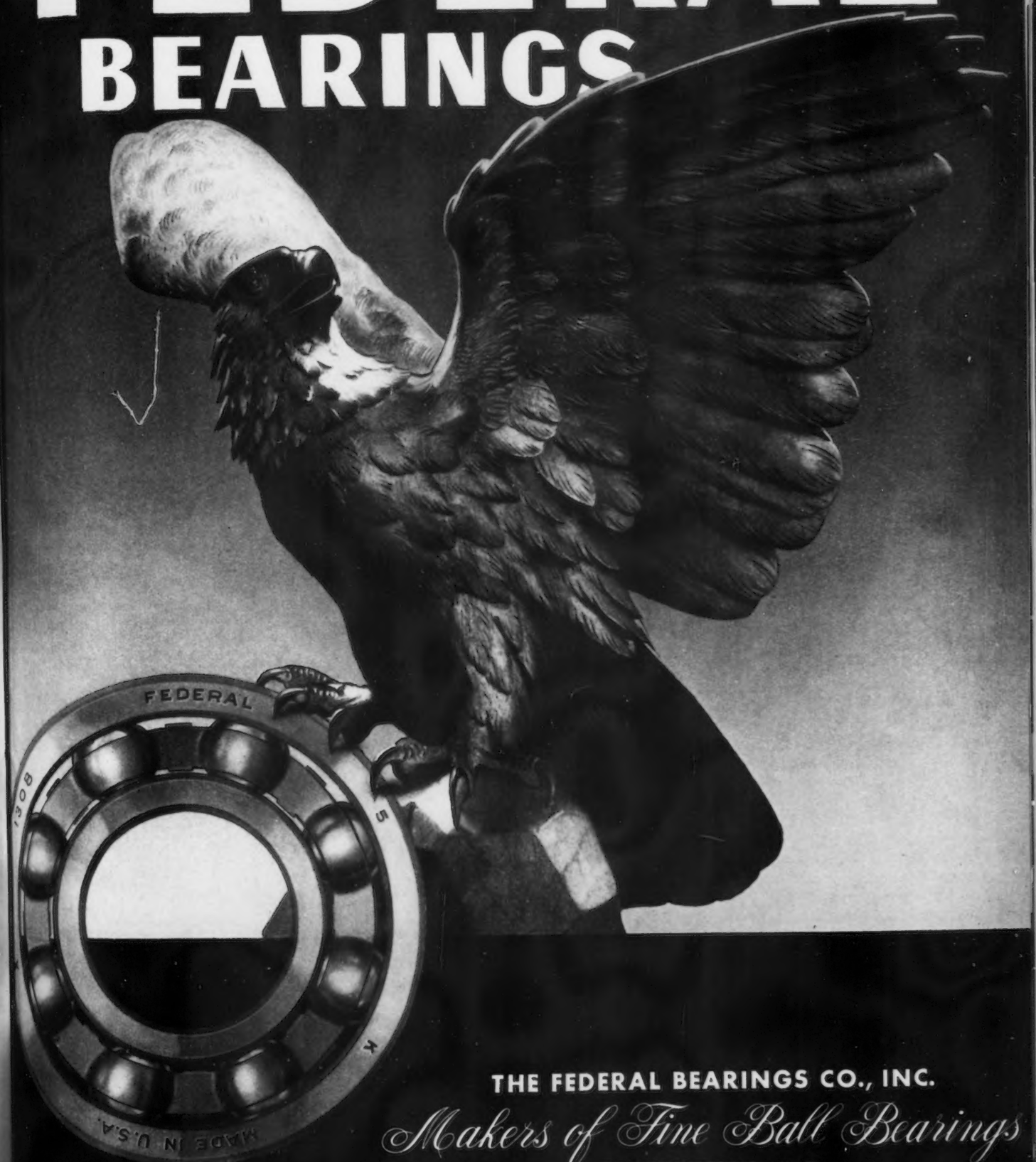
FARREL-BIRMINGHAM SYKES type continuous herringbone gear reducer units are now available in a wide choice of sizes and capacities.



FEDERAL BEARINGS



THE FEDERAL BEARINGS CO., INC.

Makers of Fine Ball Bearings

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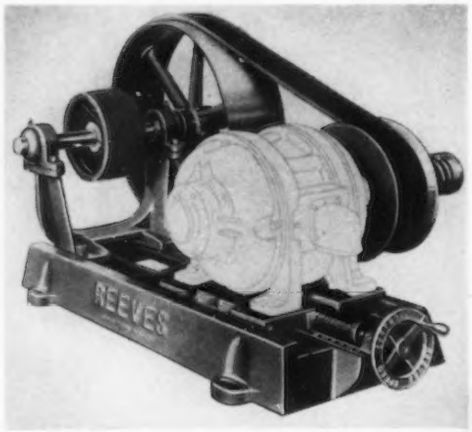
per hp. transmitted has been extremely economical.

Manhattan Rubber has developed the Paranite-G.O.P. belt from a synthetic compound resembling rubber, for use where oil causes the deterioration of rubber belting. The new Condor V-belts of the same company are hanging up enviable records for arduous service, especially in the oil fields of the mid-continent territory.



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NEW Reeves vari-speed motor pulley with countershaft, designed for use where an unusual range of speed reduction or increase is desired.

o o o

Dayton Rubber announces a new oilproof V-belt made from a synthetic rubber compound, which is especially advantageous for use on machine drives where excessive oil conditions are encountered.

Goodyear Tire & Rubber has just announced a new close-matched multiple V-drive known as "E-C" cord. Precision-built, this new belting carries the load entirely by a layer of heavy, low-stretch, high-tensile cord placed in a neutral section between high tension rubber and high compression rubber layers. Surface wear is taken by an elastic fabric envelope with the weave on the bias.

Pulleys—Vacuum Cup Metal Pulley Co. has brought out a new type of all-metal pulley with hemispherical indentations on its face creating a vacuum action when the belt passes over. It is claimed that this design eliminates belt slippage, since the belt is sealed to the pulley at the vacuum contacts, that belt tension may consequently be materially lessened for any given load, that the necessity for belt dressing is obviated, and that the belt life is materially increased. A number of large industrial concerns which have installed these pulleys report quite remarkable results.

American Pulley has developed a new Wedgbelt pulley of adjustable diameter, for V-belt drives, permitting variations in speed of from 25 to 50 per cent by various manual adjustments of the facing pulley flanges.

Metzgar Co., long known as a maker of end-wood industrial truck and caster wheels, has developed an end-wood pulley sheave of unique design, either for direct fastening to the shaft, or fitted with end-wood bearings or ball or roller bearings. This sheave is made of carefully selected hard maple, chemically treated, of all-wedge construction, with end-wood groove. The manufacturer guarantees it to be unbreakable, and claims it is silent in operation, and easy on belts, rope or cable.

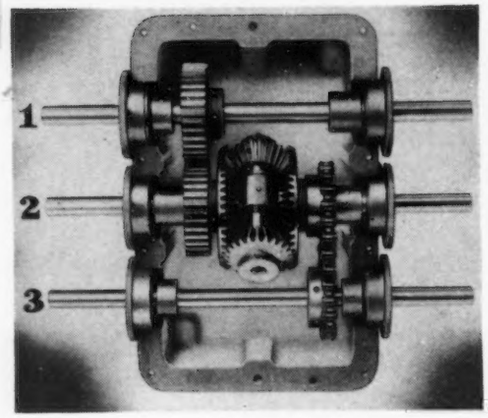
Rockwood has developed a new fiber lagging, with an improved form of clamp, to increase the diameter of pulleys and flywheels.

Pivoted Motor Bases—Both Rockwood and American Pulley have improved their pivoted motor bases in detail. The Rockwood vertical drive base is especially adapted for machine tool applications, placing the motor well up out of the way of metallic dirt, dust and chips. In this type of base the offset weight of the motor is counterbalanced against powerful restraining coil springs, in such a way as to keep belt tension uniform even when the belt stretches appreciably. In the American Pulley base the motor weight is balanced on the pivot in such a way that the reaction torque of the motor itself takes up the inequalities in belt tension, and thus keeps the tension uniform at all times regardless of load-fluctuations.

Developments in Hydraulic Transmission Equipment

Hydraulic Drives—A new Oilgear hydraulic variable speed transmission unit has been developed comprising in one integral mechanism a variable displacement fluid pump and a constant displacement fluid motor.

Hydraulic Couplings Division of American Blower Corp. has developed a heavy duty hydraulic coupling of unique design, which will be treated at length in the chapter on Hydraulic Drives to appear later in the year.



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REEVES differential, for use with variable speed transmissions, to synchronize the automatic control of two machines, or two parts of a single machine.

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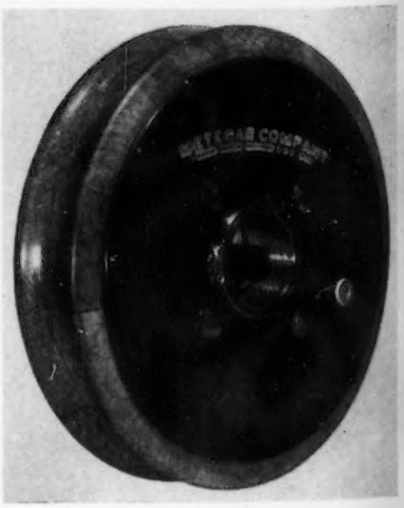


METZGAR all-wedge end-wood construction sheave, claimed to be unbreakable and remarkably easy on belts, rope or cable.

HANDLING...

Materials HANDLING...

Materials handling equipment makers in 1937 achieved $750,000,000 volume. Improvements and new developments noted in nearly all types and lines of apparatus.

o o o

By FRANCIS JURASCHEK
Consulting Editor, The Iron Age

o o o

THAT 1937 was a *very* good year for manufacturers of materials handling equipment designed for and sold to the general manufacturing industries, is evident from an IRON AGE survey just completed. This survey was limited to manufacturing operations as carried on at factories, mills and various kinds of industrial shops. No attempt was made to study the sales of equipment in the fields of construction, mining, lumbering, quarrying or other forms of raw material work.

Some 92 of the principal manufacturers of materials handling equipment were covered in the survey. It is estimated that these 92 manufacturers supplied about 95 per cent of all the materials handling equipment now in use in such manufacturing enterprises. It is further estimated that sales of materials handling equipment of all types to all such manufacturing industries within the continental United States were about 30 per cent more in dollar volume during 1937 than in 1936; and that the gross sales of such equpiment to these industries during 1937 were approximately $650,000,000. It is known that sales of equipment to the construction and raw materials industries did not fare so well, but it is believed that the gross amount approximated another $100,000,000.

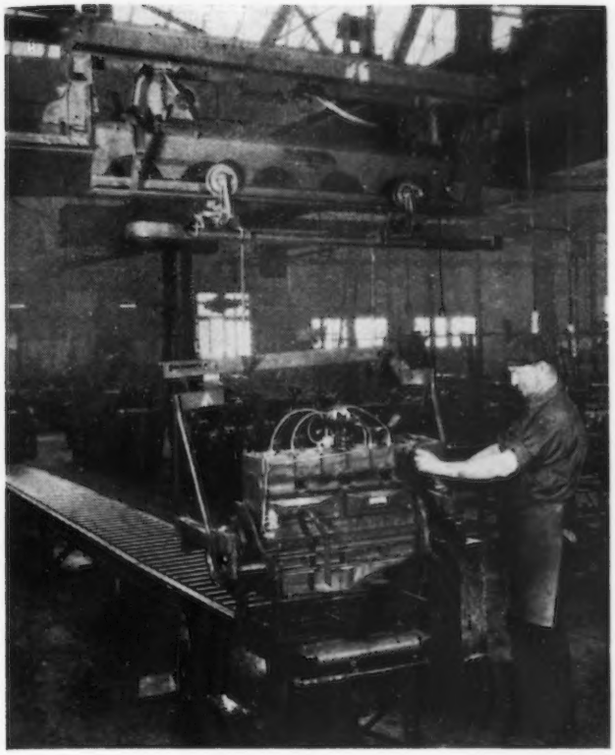
In brief, industry paid for mechanical aids to help it handle its materials and parts in process during 1937 the sum of practically three-quarters of a billion dollars. Now, in these days of thirty-seven billion dollar federal debts, and of billion dollar capitalizations of single industrial corporations, a mere three-quarters of a billion dollars looks a bit like small potatoes; but it is a sum not to be sneezed at, nevertheless. It ranks the manufacture and sales of materials handling equipment among the first 30 leaders of American industries! Furthermore, this figure is the largest total sum ever spent in any one year for materials handling equipment as a whole.

It should be stated without equivocation that accurate figures for the whole industry are almost impossible to get. Government reports do not segregate materials handling equipment, but include them in the metal working trades, electrical machinery, lumber products, rubber goods and a host of other items. Also corporation policies in many instances prohibited the release of essential sales data.

The Iron Age Survey

Nevertheless, a study of data from many sources, compared with confidential reports and an analysis of the survey mentioned above, leads the writer to believe that the estimates presented herein are substantially correct. If they are, we have witnessed, perhaps without realizing it, the growth of an exceptionally lusty infant industry, and are today looking at an infant who has yet to attain his majority. There are ample reasons for believing that another decade will see even greater growth. Before examining but two reasons for that growth, however, the survey itself merits brief attention.

Of the 92 materials handling equipment manufacturers contacted, 65 re-



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A CLEVELAND Tramrail electrically operated drop section forms a link between an overhead handling system and a gravity roll temporary storage conveyor.

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ported increased volumes of business for 1937 as compared with 1936. Of these, 43 reported increases over 25 per cent, 19 increases over 50 per cent, 9 increases over 100 per cent, 1 an increase over 300 per cent, and 2 reported that 1937 was the best year in their corporate histories.

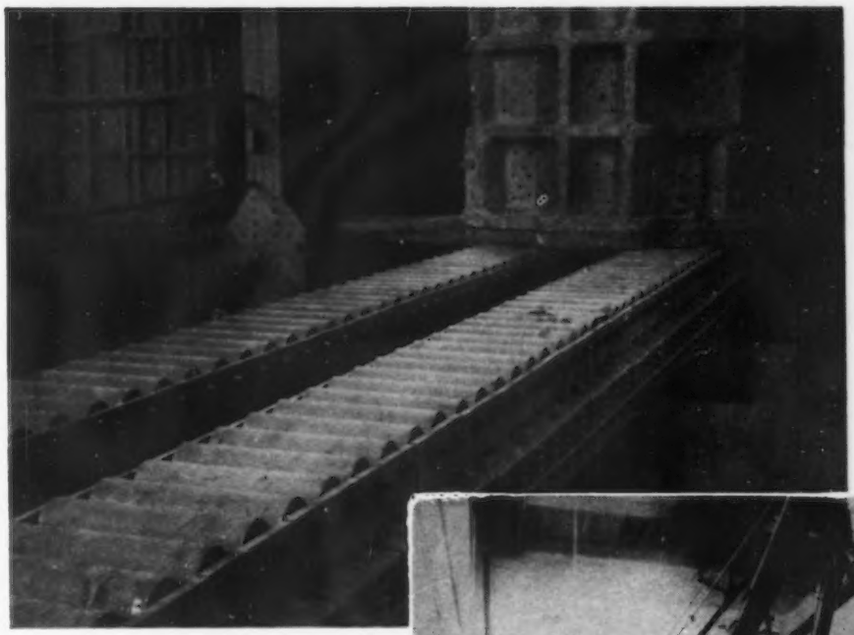
As throughout the entire capital goods industries, manufacturers of materials handling equipment scored their real gains during the first nine months of the year. In the last three months the dropping off of sales in many cases seriously affected the averages for the whole year. The opinion was freely expressed, however, that the number of sales pending, the studies made for and estimates outstanding with prospective customers, and the number of inquiries on hand presaged a volume of business in 1938 fully equal to 1937, provided Washington permitted business to roll along on its own momentum. While most of the equipment manufacturers hedged on 1938 prophecies, 26 reported that their prospects for 1938 were "good" if the recession did not last longer than the winter, four reported "excellent" prospects, three expected to do 20-25 per cent more business in 1938 than in 1937, 21 refused point-blank to hazard an opinion, and 48 ignored the question diplomatically.

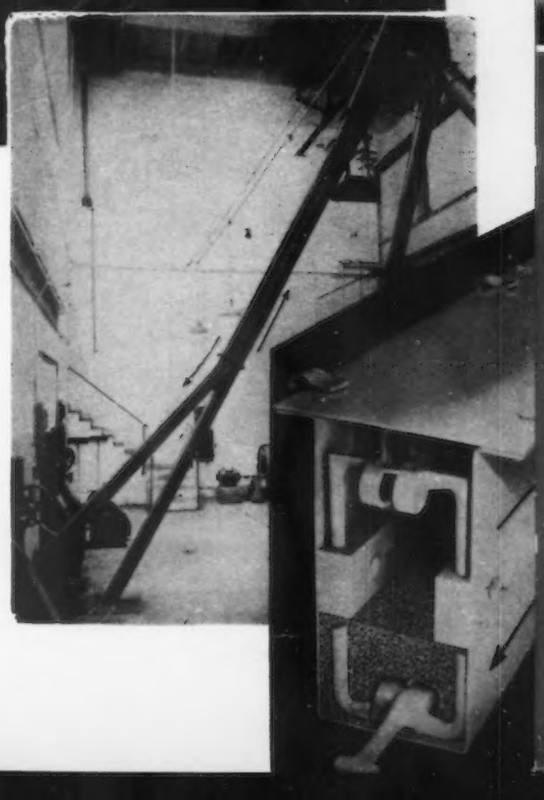
Of the 92 companies covered by the survey, 54 are conservatively rated as doing one million dollars or more business per year. Of these 54 large concerns, it is worth noting that only 11 were unwilling or unable to reveal their estimates of 1937 business as compared to 1936. Since sales figures for 1936 are available for many of the large concerns, a judicious weighting of the survey returns made possible the projection of a reasonable gross total of sales for the entire industry. It is hoped that by the time the next Annual Review issue of THE IRON AGE is due, more extended research will certify the essential validity of the basic figures for the entire industry.

Why Was 1937 Good?

Two basic factors influenced the large amount of sales of materials handling equipment during 1937. Since both these factors still hold, and will certainly influence 1938 sales, other things being equal, it will be worth while to analyze them briefly.

1—It still costs too much to move





ABOVE

A NEW Mathews spring-mounted foundry conveyor takes 10-ton molds from an overhead hoist without damage to the conveyor-roll bearings.

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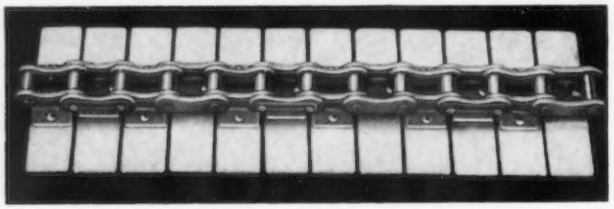
AT RIGHT

A STEPHENS-ADAMSON REDLER conveyor feeding fine coal to two industrial power plant stokers, with cross-section view of typical Redler conveyor trough.

goods. Some years ago an industrial engineer who had been studying the problems of production gave utterance to a phrase that startled industrial management: "Moving is 90 per cent of making." As an epigram it was ideal; as a bitter truth, once attention was effectively centered on the matter, it quickly became self-evident. Since that time moving costs—or as we now say, "handling" costs—have been drastically reduced in thousands of cases. But handling is still, taking it by and large, the major item in production costs, just as distribution is still the largest item in the price of manufactured goods. As the costs of handling became clearly recognized, efforts were made to reduce them to a minimum. Recognition of the symptoms and correct diagnosis of the disease must always precede a cure. We are currently in the stage of recognition and diagnosis, with here and there the cure beginning to work and producing such economic results as tend to make management blink its eyes in amazement.

2—In any period of rising costs, interest tends to become focussed more immediately on the details of production. Every effort is devoted to overcoming by technological means the upswing in the trend of rising wages and of increased material costs. It is natural that production equipment of greater efficiency should then be developed and installed, to produce more product with less labor, to produce more product from the same amount of materials, or both. When this more efficient production equipment is set up, and usually not until it is set up, the discovery is made that old methods of feeding materials to it have suddenly become obsolete, and that the full efficiency expected from the new production equipment cannot be obtained unless a modern system of materials handling, accurately keyed to the new equipment, and its higher rates of production, is installed. Coordination of production centers absolutely on getting materials *where* they are needed, *when* they are needed, dependably, and when they have been worked upon, taking them away to the next machine in the process line.

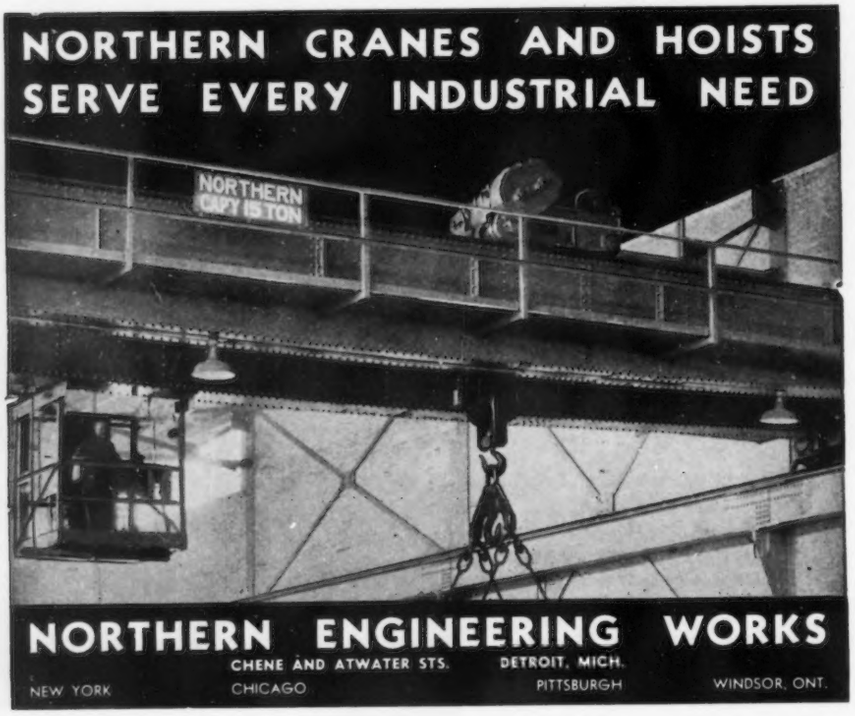


BALDWIN-DUCKWORTH has developed a new continuous plane surface roller chain conveyor for use where sanitary conditions are paramount. View shows underside.

Thus the internal discovery that handling is the key to the problem of reducing production costs generally comes with the external pressure of the rising costs of both labor and materials. Both together force the attention of industrial management on mechanical methods of materials handling as no amount of sales argument can do at other, more normal, times. The net result has been, to borrow a phrase from the market research men, to make industry "materials handling conscious." Or to put it all in the words of one of the shrewdest of the equipment manufacturers in the field: "What I consider to be the most important development of the year is the increasing awareness of manufacturers throughout the country to the tremendous importance of using the most modern and up-to-date materials handling methods and equipment available. . . . Many old industries which have been doing the same things over and over again for 40 years and more have finally realized the necessity of meeting the new conditions with modernized methods. In several of these cases we have accomplished quite remarkable results by studying the whole production problem involved, and recommending changes in layout and equipment which have resulted in a very considerable reduction in the floor space required for a given volume of production, or conversely, a tremendous increase of production for the same floor space. The installations which we have made in this connection have permitted workers to earn more money in fewer hours, and at the same time have reduced the cost of the completed articles to the manufacturers. At the bottom of this is the awakening of industry in general to the essential truth of the statement that mechanical handling is the only safe route to higher wages and shorter hours."

Progress Review

A study of the progress made during the year in both methods and equipment shows that two major points have marked the design thinking of practically every equipment manufacturer. The first of these has to do with the elimination of all unnecessary rehandling operations of every kind. The newer equipment tends to become more and more a



MOVE MATERIALS with EASE and ECONOMY

—ATLAS—

HAULING UNITS for specific purposes are comparable to specialized machine tools in utility and convenience. We have produced dependable hauling equipment for many difficult situations. Whatever your needs may be, see what Atlas offers. It is quite possible problems similar to yours have already been solved.

●

CARS—LOCOMOTIVES
INDUSTRIAL TRUCKS
AND TRACTORS

●

The ATLAS CAR & MFG. CO.
CLEVELAND, OHIO

SCALE CAR

400 CU. FT.
This big 2-compartment bottom-dump car was built for limited head-room. It also shifts horizontally to pass between columns. There are double trucks, ball bearings, and air-operated gates and brakes. Has Atlas scale indicating *and* recording dial.

CUPOLA CHARGING

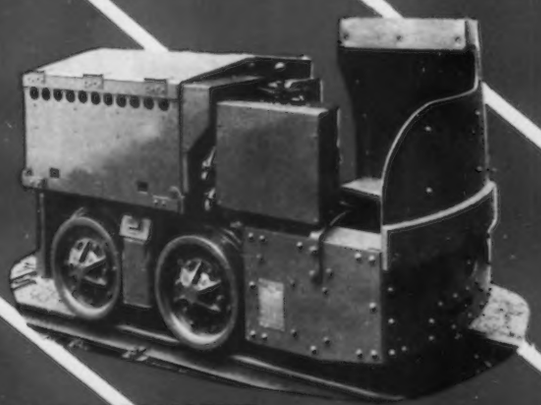
Scale Car, 2½-Ton. Roller conveyors for coke and limestone are mounted on the scale. Others, for empty buckets and iron (weighed separately), are on the car frame. Atlas Dial scale reads *and* records ladings.

CENTER BOTTOM DUMP CAR

This single-compartment 30-ton ore transfer car has Harrigan type air-operated gates, pusher arm, electrically heated hopper. Two motors for each truck.

30-TON GAS-ELECTRIC

4 standard gauge locomotive, with 175 H.P. 6 cylinder engine, generator, two traction motors, and single control. A.A.R. engine couplers, and Standard Air brake equipment.

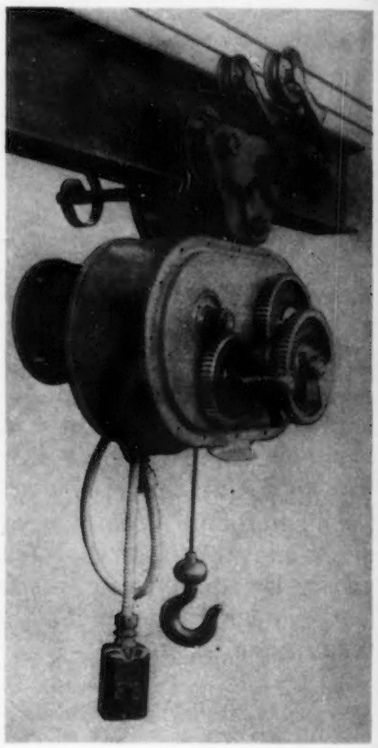


BATTERY LOCOMOTIVE

This 1½ ton worm drive locomotive for metal mine haulage. Has safety interlock switch. A cab, with rubber lined head rest, protects the operator.

complete handling system, with means developed to pick up and discharge loads as well as to transfer them from point to point, without external assistance. The second point has to do with the refinement of the equipment, to the end that less energy need be expended to effect the handling operations, to pick up, move and discharge loads more quickly, to handle larger unit loads, and to redesign the essential equipment along more compact, stream-lined forms, involving the use wherever possible of lighter alloy metals, welding of parts instead of riveting, and the use of improved, quicker-acting control mechanisms. Other factors of design are almost always subordinate to these two points.

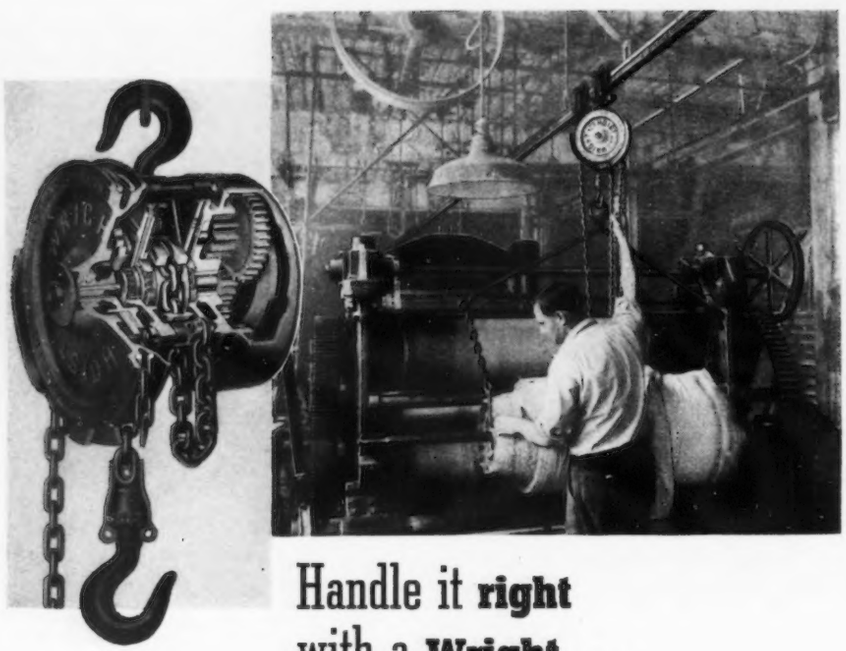
Unfortunately, it is quite impossible to illustrate within the limits of this one paper even a small part of the new equipment brought out during the past year. There is only space to highlight a few of the more interesting (but not necessarily the most important, economically speaking) of these developments. During the year many of them will be described in greater detail, as opportunity affords. For the sake of convenience the material here is roughly divided into four classes; 1—Conveying equipment, 2—Hoist and crane equipment, 3—Mobile truck equipment, and 4—Equipment of other types not readily classified as above.



THE new 1/4-ton capacity American Engineering Lo-Hed hoist is designed for service where limited clearances between hook and supporting beam are essential.

Conveying Equipment

Overhead conveyors of the trolley supported endless chain type have earned high regard as a means of making assembly work more efficient, and also for use in actual processing operations of various kinds. This subject was touched upon briefly in the Nov. 11, 1937, issue. Since then a large number of photographs have been received of new installations embodying many points of interest, as, a Chain Belt installation handling domestic stove tops through inspection, drilling and fitting together operations; a Link-Belt installation showing the assembly of all-metal folding chairs; a Mathews installation involving the handling of automotive axles



Handle it **right** with a **Wright** . . .

● The inherently fine construction of the Wright High Speed Hoist makes it an exceptionally efficient production tool.

Every feature of this hoist spells quality—the zinc coated finish which defies corrosion; the precision load wheel bearings; the load chain guard and all the rest of the twenty-one features, assure you a hoist which will amply meet all requirements.

The illustration above shows a Wright High Speed Hoist in use as a production tool in a large rubber plant. This is but typical of the many industries which consider the Wright to be just right for their purposes.

The new Wright catalog will be extremely helpful to you in many ways. Write for it right now.

WRIGHT MANUFACTURING DIVISION
AMERICAN CHAIN & CABLE COMPANY, INC.
YORK, PENNSYLVANIA

In Business for Your Safety

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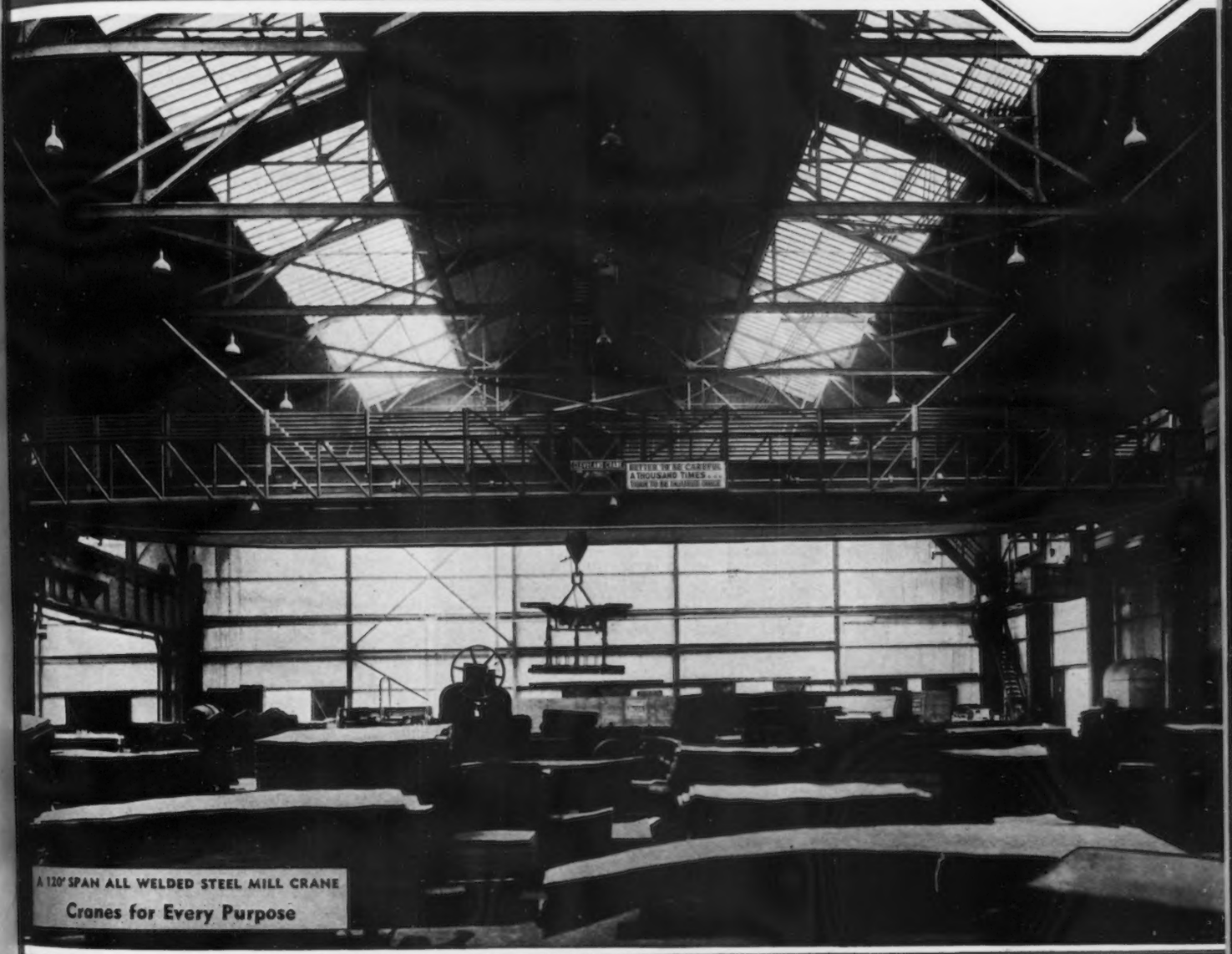
WRIGHT *Improved High Speed* **HOISTS**

HANDLING EQUIPMENT
LOADS 50 POUNDS TO 500 TONS

CLEVELAND CRANES



A 120' SPAN ALL WELDED STEEL MILL CRANE
Cranes for Every Purpose

CLEVELAND CRANES ALL WELDED ROLLER BEARING

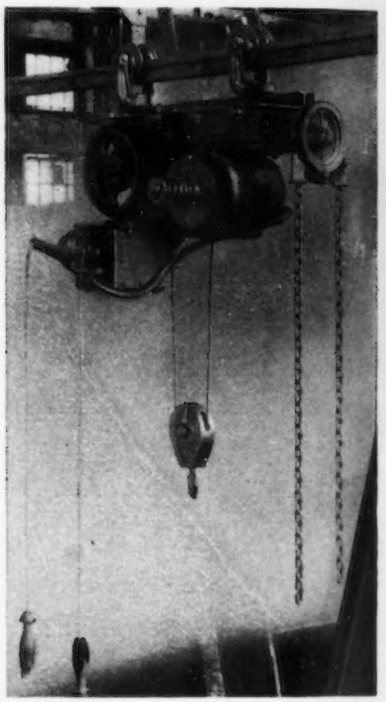
& ENGINEERING CO.
WICKLIFFE, OHIO

FOR CRANES . . .
CONTACT WICKLIFFE - NEW YORK
DETROIT - PITTSBURGH
CHICAGO - BIRMINGHAM

through a pickling tank; a Mechanical Handling Systems installation carrying all-metal automobile bodies down an assembly line. An interesting new Jeffrey installation solves the troublesome problem of disposing of three different kinds of flash from drop forgings at an automotive plant by means of an automatic trolley conveyor collecting system. Manual handling is confined to the one operation of loading the skip-hoist buckets located at each trim-press. When the bucket is filled the operator pushes a control button, the bucket rises to a receiving hopper, dumps its load and returns to the main floor level for further loading. The hopper discharges automatically to a selective trolley conveyor system which in turn discharges each type of flash into its own storage bin at the end of the line.

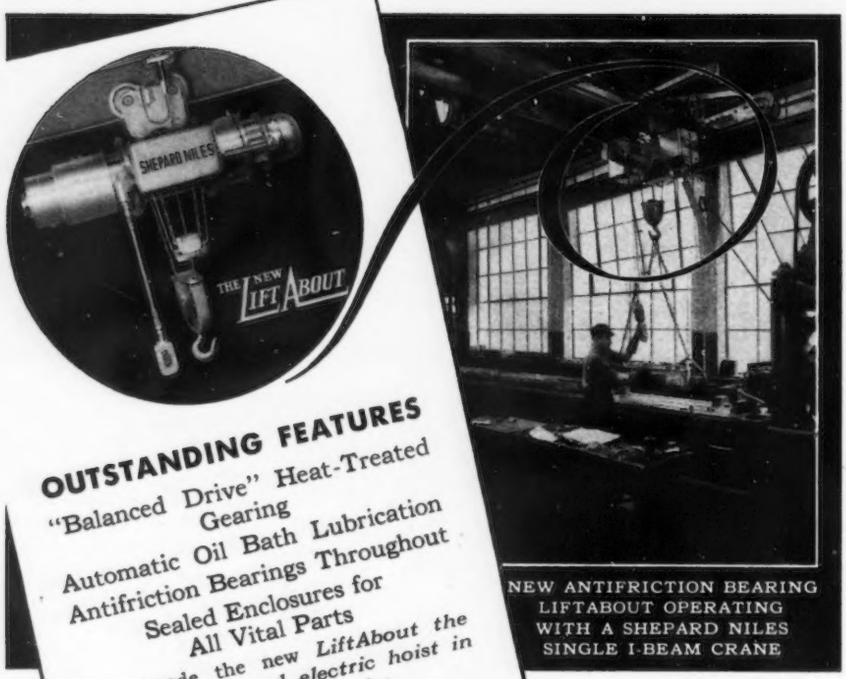
Tramrail systems have developed even more complete-coverage capacities. A new American Monorail installation in an airplane factory has a large number of overhead monorail tracks radiating outward like the spokes of a wheel, from a central receiving point, covering virtually every square foot of the floor area in a department where thin metal is shaped over wing and fuselage parts. The hand-operated trolleys will carry loads up to three tons each, and take all handling operations off the working floor. A new electrically operated tramrail drop-section developed by Cleveland Tramrail forms an effective connecting link between overhead handling in a large automotive engine plant and temporary lines of gravity roller conveyor storage. Hairpin hooks are carrying heavier loads today; a Louden overhead track system features hooks which carry large coils of wire directly into and out of annealing furnaces, and a Cleveland Tramrail development on the Pacific Coast carries a suspended operator's seat on a trolley-hoist carrier with the hairpin hook enlarged to handle pallet loads of kegs, drums or barrels.

The increased use of steel mill conveyors in connection with the continuous rolling, pickling, trimming and shearing of strip steel has been one of the outstanding developments of industrial materials handling during the past two years, shared largely



THIS Robbins & Myers electric hoist has a mechanical drive which gives hoisting speeds of 26 to 52 in. per min. for dip-painting processes, etc.

The new LIFT ABOUT
ELECTRIC HOIST
CAPACITIES ONE-EIGHTH TO TWENTY TONS



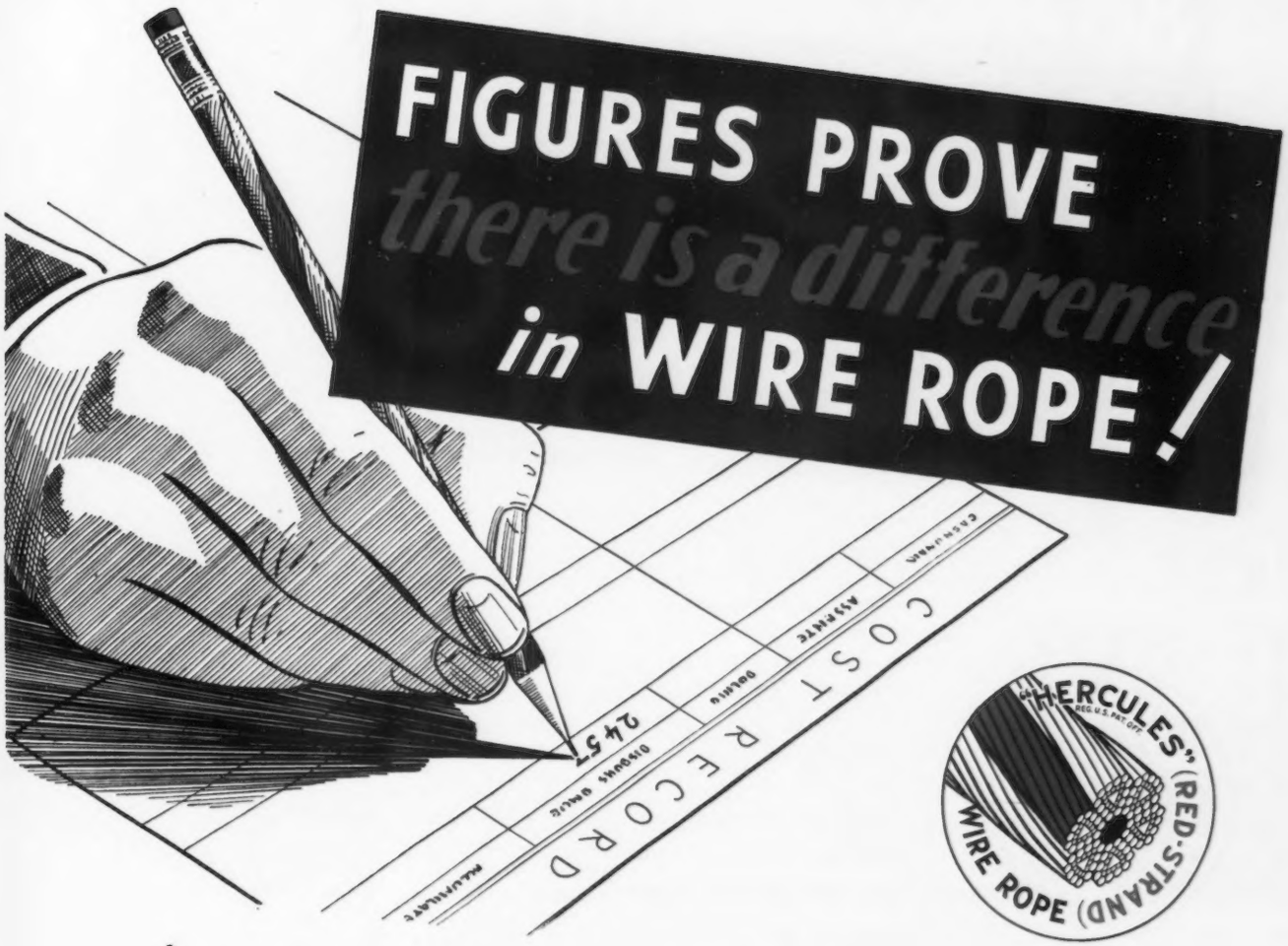
NEW ANTIFRICTION BEARING LIFTABOUT OPERATING WITH A SHEPARD NILES SINGLE I-BEAM CRANE

OUTSTANDING FEATURES
"Balanced Drive" Heat-Treated Gearing
Automatic Oil Bath Lubrication
Antifriction Bearings Throughout
Sealed Enclosures for All Vital Parts
have made the new *LiftAbout* the most widely used electric hoist in American Industries.
WRITE FOR BULLETIN No. 126

SHEPARD NILES CRANE & HOIST CORP.

A Complete Line of CRANES AND HOISTS

356 Schuyler Avenue, MONTOUR FALLS, N. Y.



Differences not visible in the appearance of wire rope . . . soon become noticeable in the cost records.

The value of "HERCULES" (Red-Strand) Wire Rope is a matter of simple arithmetic—the increase in its length of service means a decrease in its cost. Its real economy depends upon added performance—not on a price tag.

A sure way to keep your wire rope costs low is to specify "HERCULES" (Red-Strand) Wire Rope. It is consistently dependable and longer lasting—as fine a rope as 81 years of manufacturing experience and acid open-hearth steel wire can make. Furnished in both Round Strand and Flattened Strand constructions.

For Maximum Efficiency in Preformed Wire Rope, Use . . .

PREFORMED
"HERCULES"*
RED-STRAND
WIRE ROPE

Available in Both Round Strand and Flattened Strand Constructions

*Reg. U. S. Pat. Off.

Made Only By

A. Leschen & Sons Rope Company

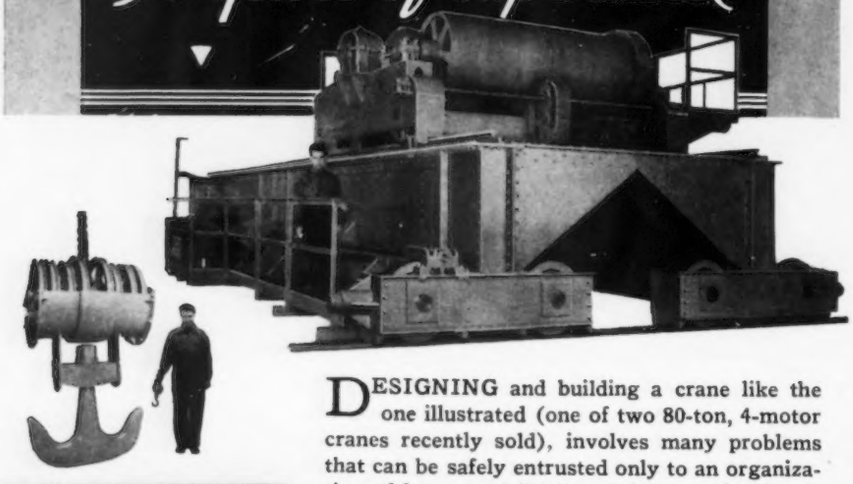
Established 1857

5909 Kennerly Avenue

ST. LOUIS, MO.

New York	90 West Street	San Francisco	520 Fourth Street
Chicago	810 W. Washington Blvd.	Portland	914 N. W. 14th Avenue
Denver	1554 Wazee Street	Seattle	2244 First Avenue South

80 TONS of CAPACITY
REFLECTING
30 years of experience



DESIGNING and building a crane like the one illustrated (one of two 80-ton, 4-motor cranes recently sold), involves many problems that can be safely entrusted only to an organization of long specialized experience and training.

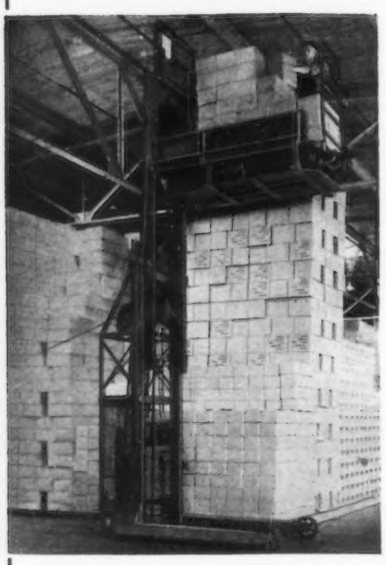
Euclid's experience in crane design covers a third of a century, and we believe justifies your complete confidence.

Ask for catalog and tell us your crane problem. We will work with you.

EUCLID CRANES & HOISTS

THE EUCLID CRANE & HOIST CO.
1361 Chardon Rd., Euclid, Ohio

Pile 'em high!



"Pile 'em high" seems to be the order of the day in most warehouses and stock rooms where space is at a premium, and overhead space is at most times wasted. Yet, "piling 'em high" represents no little difficulty if the piling has to be done by hand.

The Service Lifter provides vertical transportation for anything that can be stacked . . . barrels, boxes, cartons, cases, crates, or any other items of regular shape.

The Lifter pictured can be built in any lift up to 30 feet and in any capacity up to 30,000 pounds.

A request on your letterhead will bring complete information.

THE SERVICE CASTER & TRUCK CO.

511 N. Brownswood Ave., Albion, Mich.

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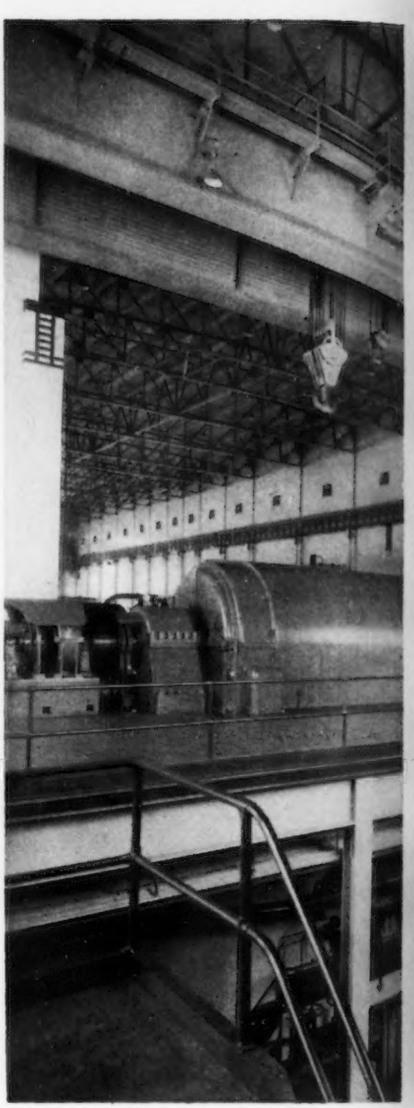

A WHITING 250-ton power house crane in auxiliary hoist. Span

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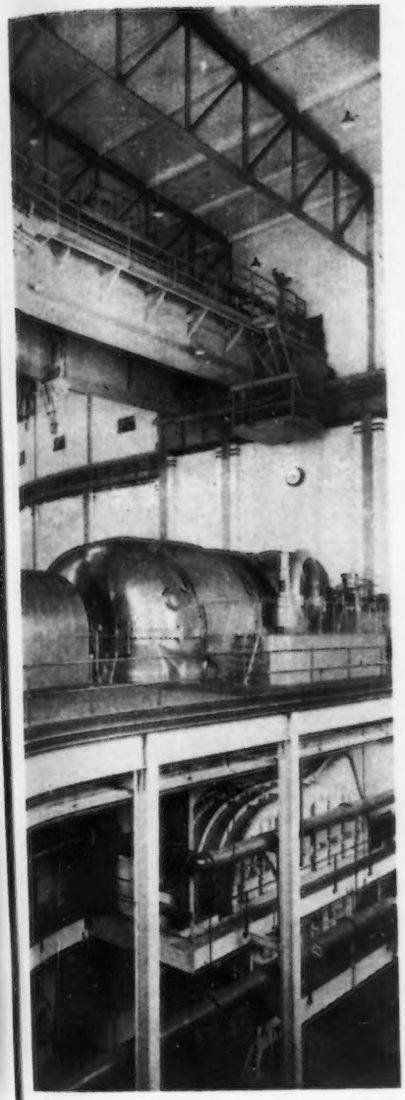
by Logan, Standard Conveyor and Mathews. Numerous articles on this subject have appeared in THE IRON AGE during 1936 and 1937, and others are now in preparation. Roller conveyors are likewise coming into more widespread use in foundries, and here Mathews has introduced a spring-suspended roller conveyor, especially designed to absorb the shock of depositing heavy molds by crane hoist on the conveyor from the shakeout. The spring suspension adds years to the life of the conveyor-roller bearings.

Belt conveyors have been improved mainly in the matter of belting. B. F. Goodrich has announced a new cord construction conveyor belting which is said to give considerably longer wear than belts of the fabric-carcass type. With no transverse or filler threads obstructing complete freedom



a large utility central station, with a 25-ton 133 ft., lift 65 ft.

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of movement, this new belting is flexible in every direction. This feature of added flexibility supplements the natural wearing qualities of the cover to a degree where resistance to impact, cutting and gouging is materially increased. Manhattan Rubber installed 3620 ft. of 12-in., 4-ply conveyor belt in the pre-cooling and storage departments of one of the world's largest fruit processing plants, and developed the Paranite-G.O.P. conveyor belt from a synthetic composition resembling rubber, for use where oil conditions produce a deleterious effect upon rubber belting. Other notable recent developments in belt conveyors, including the Link-Belt center-guide belt, were described in the issue of Aug. 5, 1937.

The principal package conveyor developments by Logan, Standard Conveyor and Lamson were along the

READING cooperates with PARISH to lower handling costs

THE NEW addition to Parish Pressed Steel is built to handle work on a modern fast-production basis. This 100-foot span Reading Crane is an important unit in the production set-up.

Reliable, time-tested Reading Hoists are keeping things moving in hundreds of steel mills, foundries and fabricating plants. You can rely on the new, fleeter, smoother Reading Hoists to render the same rugged service for which Reading equipment has been famous for 30 years.

READING CHAIN & BLOCK CORPORATION, READING, PA.

READING

CHAIN HOISTS • ELECTRIC HOISTS
TRAVELING CRANES • MONORAIL SYSTEMS

o o o

TOWMOTOR truck designed for handling ladles of molten metal to die-casting machines. Operator can pour the ladle to either side of the swinging boom.

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lines of improved manual and automatic switches designed to shunt the loads from a main line roller conveyor onto various side or terminal conveyors. A chapter in the series of articles on the "Economics of Materials Handling Methods and Equipment" will shortly be published dealing especially with the subject of package conveyors.

The Redler conveyor, manufactured by Stephens-Adamson, for the handling of bulk or granular materials, has forged ahead rapidly in the past year, with improved constructional details. The working principle is shown in the illustration reproduced of a stoker-feed installation. In an enclosed trough an endless chain draws arms so shaped that they both slip through, and draw the material to be moved along the trough. Because of this quality of slippage, very little power is required to move the

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A BAKER tilting fork truck with center control for handling pallet loads; particularly of sheet steel or tin plate.

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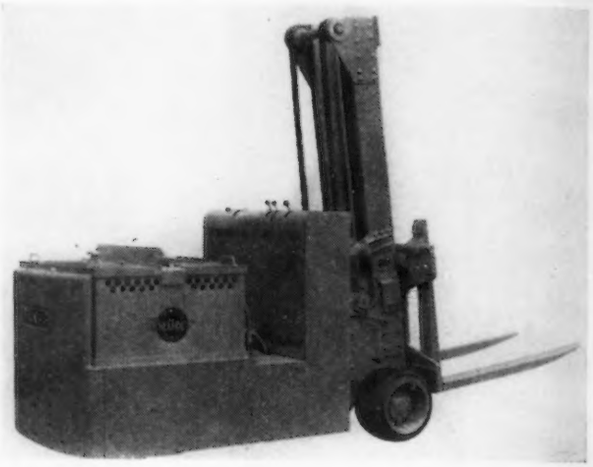
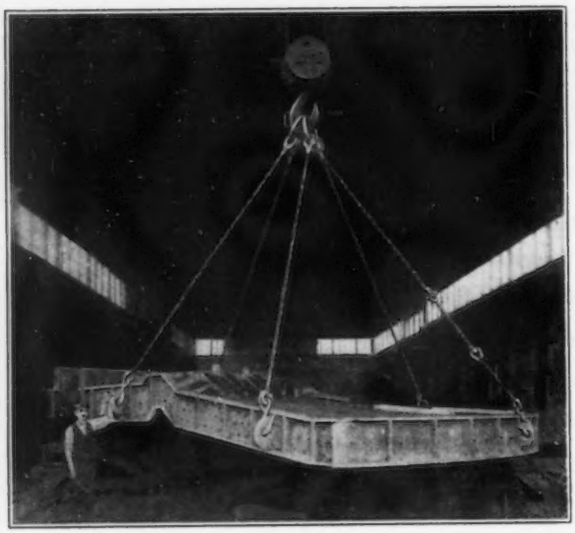
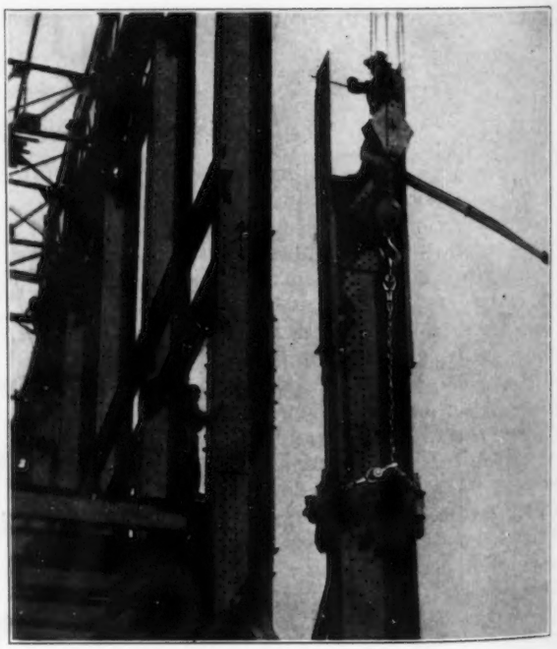




Handling large foundry flask with a Plaited Endless Triple and a Twin Murray Safety Sling—with turnbuckle for leveling adjustment. Total capacity, 45 tons.



RAISING A 15-TON COLUMN

Slings Without Kinks

Ask riggers who have used them. They know Murray Slings of plaited wire rope straighten themselves out without kinking. That means *safety* and long life. In the 16 years we have been making these slings, we have yet to hear of the first failure. Moreover they are pliable, for rapid adjustment.

Slings for every purpose and capacity—made by the original manufacturer and patentee.

MURRAY SAFETY SLING CO., Inc.

ESTABLISHED 1921

33 WATER ST. PITTSBURGH, PA.

chain, yet the efficiency of moving is high.

Chain Belt chip and log-hauling chain conveyors in improved types have had a large sale in pulp paper mills, and Link-Belt has brought out a new super-steel elevator bucket with greatly increased life.

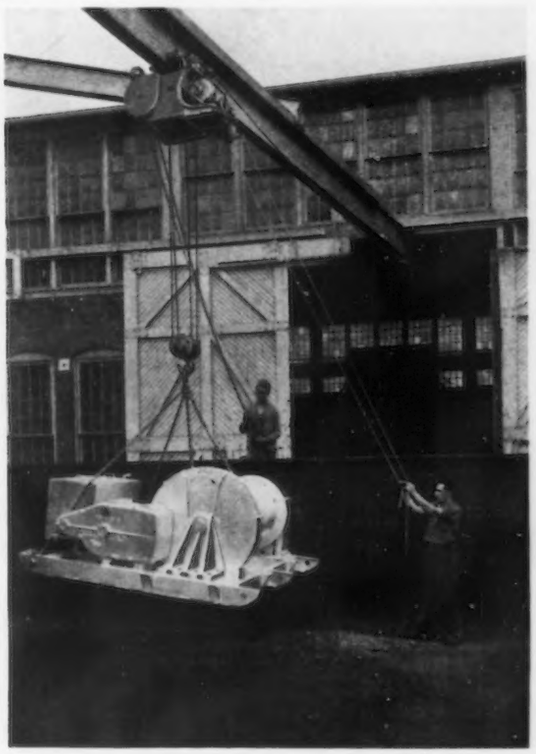
An illustration is reproduced of the underside of the new Baldwin-Duckworth continuous plane surface single roller chain conveyor, especially adapted to situations where sanitary handling conditions are paramount. Jeffrey reports that, by the use of special alloy steels and methodical heat treatment, feeder and catcher chains on sheet steel rolling applications have been given 50 to 100 per cent greater life expectancy than heretofore; and that by means of special designs and improved manufacturing methods the life of annealing furnace chains has been lengthened as much as 50 per cent.

HAISS continuous chain and bucket conveyor loader with breaker arms, digging clay. A self-contained unit, mounted on caterpillar treads.

Hoists and Cranes

The American Engineering Lo-Hed ¼-ton capacity hoist illustrated is an extremely compact job which makes it possible to raise the load very close to the bottom flange of the supporting beam. The Harnischfeger light, quick-acting Zip-lift electric hoist is likewise a close-clearance job of merit. The Robbins & Myers hoist illustrated was designed to give very

ONE GOOD HOIST *deserves another* R & M



Industries that have watched *one* R & M Hoist daily demonstrating its efficiency and reliability are quick to see the need for more. Check the place where additional hoist equipment will speed up your operation and cut costs. We'll help you to specify the right hoist for the job.

Write for Bulletin 6161, giving complete data on R & M Hoists and Cranes for every type of service.

ROBBINS & MYERS

HOIST AND CRANE DIVISION . . SPRINGFIELD, O.

slow hoisting speeds through a mechanical drive, being adjustable from 26 in. to 52 in. per min. This control gives the advantages of a constant, predetermined hoisting speed for such applications as dip-painting, doping, etc. A new Robbins & Myers 5-ton, 2-motor crane is of the so-called "submerged" type, and is especially designed to operate on the same runway and to give the same lift and approach as a hand-power crane and hand chain hoist.

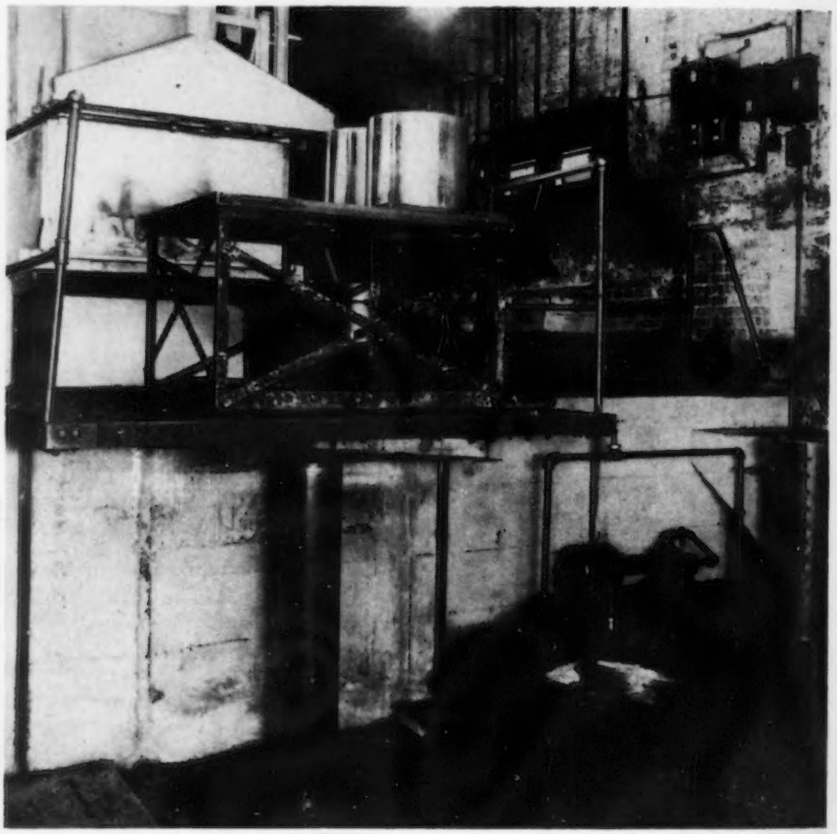
Shaw-Box Crane & Hoist has issued a praiseworthy treatise entitled "A Book on Crane and Hoist Engineering." This 222-page, cloth-bound manual actually analyzes hoist and crane problems for the layman, and contains a complete set of outline specifications for the purchase and installation of hoist and crane equipment, besides a large number of useful engineering tables. It is only incidentally a catalog of Shaw-Box equipment. Among the Shaw-Box developments of the year are included a wider use of flame-cutting and welding in crane construction, a light capacity electric hoist known as the "Load Shifter Junior," for loads of 350 lb. and 700 lb., and a new type of drop-pit table for wheeling and unwheeling locomotives.

American Monorail has applied its Monotractor device to a 5-ton electrically operated crane. A pair of pneumatic balloon tired wheels mounted at each end of a drive shaft spanning the girders from which the crane is suspended, are caused to rotate by a small electric motor, and pressing firmly against the beam flanges, move the crane rapidly and dependably. American Monorail has likewise developed a new heavy duty 3-way switch for I-beam section overhead trackage.

A new Electro-Lift rope guide worm-drive electric hoist in capacities from ¼ ton to 5 tons has a deeply grooved drum permitting the cable to be completely submerged in the grooves, and a traveling finger guide which runs in the groove ahead of the cable. This hoist has been especially designed for use where side and end pulling may be encountered, or wherever the load cannot be brought directly under the hoist.

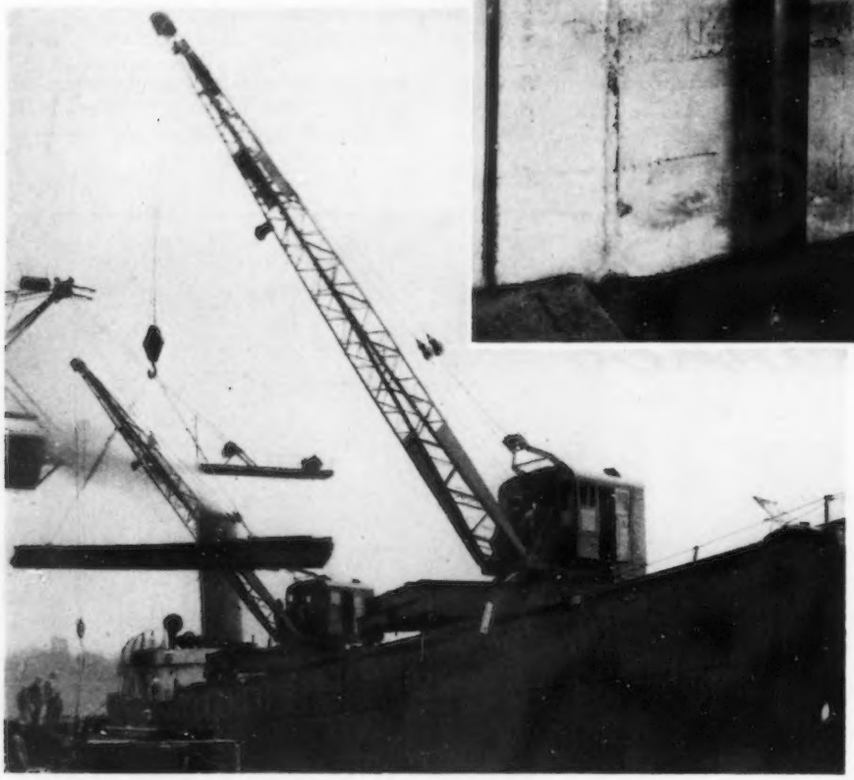
Euclid Crane & Hoist reports recent sales of a new 70 and 80-ton main hoist, 10-ton auxiliary hoist, 4-motor, cab-operated crane with unusual construction of end trucks. Whiting Corp. has developed a 15-ton, 5-motor, 100-ft. span, 25-ft. lift crane for handling structural steel, which has proved very satisfactory. Another interesting Whiting installation is a 250-ton power house crane for turbine room use, with 25-ton auxiliary hoist. Both hoists have two hooks, and the crane spans 133 ft. and has a total lift of 65 ft.

Northern Engineering has made a number of interesting installations of 7½-ton and 10-ton shop cranes of medium span and lift, and Conco



A CURTIS PNEUMATIC MACHINERY air-operated hydraulic cylinder platform lift which is very economical in operation between two intermediate levels.

o o o

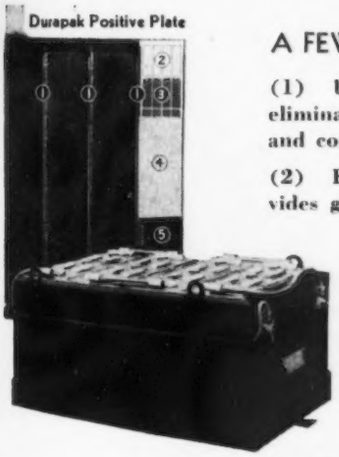


TWO Industrial Brownhoist electric ship cranes travel the ship-length over all hatches. Especially adapted to handle structural material and package cargoes.

1938 CHALLENGES INDUSTRY TO REDUCE OPERATING COSTS

Here is a proven way to do it. Equip your electric trucks with USL Durapaks. You'll get more work per hour from your trucks because USL Durapaks deliver more power! You'll reduce your battery replacement costs because USL Durapaks last longer!

There are definite reasons for this. USL Durapaks are revolutionary in design — different from any other storage battery —the crowning achievement of 38 years of battery engineering.



A FEW REASONS WHY USL DURAPAKS GIVE MORE POWER AND LONGER LIFE

(1) Unique "Sectional" Plate Construction eliminates plate failures due to expansion and contraction stresses.

(2) Extra Heavy One-Piece Plate Grid provides greater mechanical strength and longer plate life. Extra heavy grid bars (85% greater than frequently used) provide quicker flow of current from plate and greater electrical contact between plate frame and active material. Result—greater output under heavy loads and longer plate life.

(3) Activite, the Special USL Plate Material is more active chemically and gives USL Durapaks greater electrical output.

(4) Glass Filter Pads prevent plate material from shedding off plates, assuring longer battery life.

(5) Porous Rubber Plate Shields (a remarkable new material) hold glass filter pads firmly and permanently against plate and allow quicker diffusion of electrolyte between plates. Result—longer battery life and greater power output.

USL BATTERY CORPORATION, NIAGARA FALLS, NEW YORK
(A Division of the Electric Auto-Lite Company)

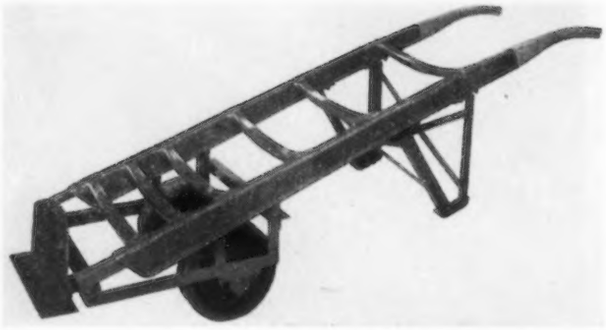
USL DURAPAK BATTERIES
BUILT TO LAST

FOR INDUSTRIAL TRUCKS . . . BATTERY LOCOMOTIVES . . . STREET TRUCKS . . . RAILROAD CAR LIGHTING AND AIR CONDITIONING . . . MARINE SERVICE . . . OTHER USL BATTERIES FOR POWER CONTROL EMERGENCY LIGHTING . . . DIESEL STARTING . . . TELEPHONE . . . AUTOMOBILES, BUSES AND TRUCKS

Engineering Works is specializing in low-headroom, high lift shop cranes up to 10 tons capacity and 60-ft. span.

Both Cutler-Hammer and Ohio Electric have brought out new super magnets of about 65 in. diameter, with extreme lifting capacity, especially designed to lift from one to four coils of strip steel at a time, with uneven edges, and unbanded, directly from the hot mill. These magnets will materially cut the costs of handling coils weighing to 9000 lb.

In the hand hoist field, Chisholm-Moore has brought out a light weight spur-geared chain block which can be shifted from one application to another with greater ease because of its lighter weight, and McCollum Hoist & Mfg. has a new screw-geared chain hoist for which a 25 per cent increase in efficiency is claimed.

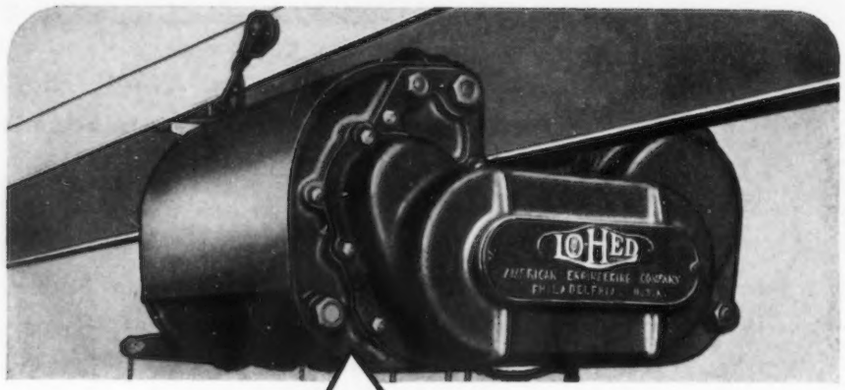


A NEW American Pulley pressed steel frame paper roll truck with hinged toe, which facilitates heavy roll handling in warehouses and printing plants.

The new Wellman Engineering blast furnace skip hoist uses welded construction for post brakes, brake arms, counterweight, speed control and safety devices. The bedplate is made of heavy, welded beams with wide flanges and the herringbone gear reduction cases have cast steel, ring oil bearings welded to the steel plate, with all stresses relieved to eliminate any possible distortion. Wellman is likewise building larger capacity open-hearth charging machines of up to 12 tons capacity, has developed a new quick method of charging whereby the entire charge of cold metal required for a melting is deposited in the furnace at one time, and is now licensed to manufacture and sell top-charging open-hearth furnaces under the Griggs and Leeks patents. Whiting Corp. has brought out a new foundry cupola skip-hoist charger, and has done extremely well during the past year with its wishbone-type overhead crane charging equipment.

Industrial Brownhoist electric ship cranes are now available for mounting on a vessel so as to run the full length over all hatches. These cranes are especially practical in the handling of structural material or package cargoes. Industrial Brownhoist ore-bridge cranes of up to 10 tons capacity are coming into widespread use at steel mills to place coal, ore, limestone, etc., in and out of storage. Some of these storage piles frequently contain several hundred thousand tons of material.

Curtis Pneumatic Machinery reports an increased demand for pneumatic and hydraulic handling equipment in capacities up to 10 tons, particularly in processing operations where materials have to be raised or lowered repeatedly, at low cost. A



A High Factor of Safety Here

Assures Safer Handling Here

Specify *THE* hoist with the highest factor of safety!

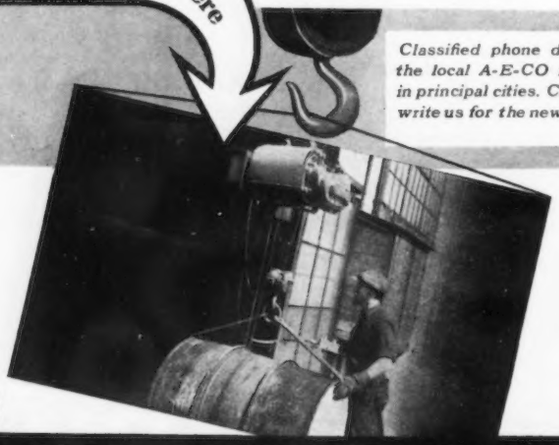
Let the nearest A-E-CO representative show you why A-E-CO Lo-Hed HOISTS are the safest hoists built.

Ask him to explain Lo-Hed's exclusive features that mean constant, dependable performance and lower maintenance cost.

Let him show you Lo-Hed's uses in scores of industries.

Find out *why* Lo-Hed is the logical hoist for EVERY purpose and why it is the *only* hoist for low headroom conditions. A-E-CO Lo-Hed HOISTS are built in 98 standard models—from ¼ to 12 ton capacities.

Classified phone directories list the local A-E-CO representative in principal cities. Call him in... or write us for the new hoist catalog.



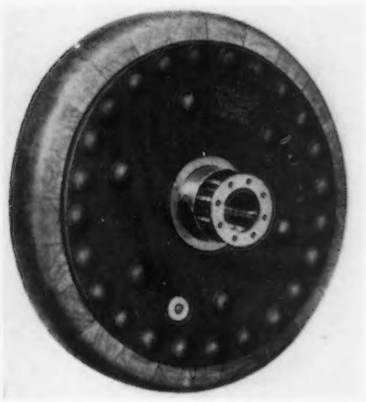
AECO Lo-Hed HOIST

AMERICAN ENGINEERING COMPANY

2410 ARAMINGO AVENUE, PHILADELPHIA, PA.

typical new Curtis installation of an air-operated hydraulic lift is shown.

Electric, gas, and gas-electric powered industrial trucks have been graduating rapidly into completely self-contained material handling systems. So many new designs are now available that it is impossible to present even a fraction of them here. A portfolio of illustrations was published in the issue of Nov. 25, 1937, and several articles devoted entirely to the newer types of industrial trucks are to be published in the near future. It should be particularly noted here that ram trucks and fork trucks, tilting, tiering and telescoping; trucks with articulated frames; trucks with center control; trucks with huge cranes and load-carrying trucks with capacities up to 30,000 lb. and more, are the highlights. Among the noteworthy developments are new models by Automatic Transportation, Baker Raulang, Clark Tructractor, Elwell-Parker, Howell, Mercury, Silent Hoist & Winch, Towmotor and Yale & Towne. Ready-Power has kept pace with new gas-electric units for all types of trucks and tractors. Atlas and Lakewood have likewise enjoyed good sales, although new models are not evident.



THIS Metzgar wood-tread wheel for industrial trucks, tractor, trailers and hand trucks is said to have many advantages in heavy duty service.

Other Types

Haiss self-contained conveyor-loader units have been developed amazingly in the past year. Metzgar sectional wood-tired wheels for industrial trucks of all kinds used in heavy duty service, have certain advantages of note, and have proved to be definitely economical in many cases. Revolvator has enlarged its line of elevating and tiering lift trucks, hand operated. Atlas has forged ahead with special types of industrial railway cars for special purposes, and both Porter and Whitcomb have brought out new industrial locomotives of exceptional merit. Lewis-Shepard has a new hand-operated platform-lift truck; Clark has a new tubular steel tote-pan truck; American Pulley has a new pressed steel paper roll truck with a hinged toe which facilitates the picking up of heavy rolls; Sabin has a new pressed steel barrel and drum truck with pneumatic tires; Service Caster & Truck a new high-lift tiering truck; Barrett-Cravens has enlarged its lift truck and tiering truck line greatly; Lyon Iron Works has a new hydraulic lift truck for handling two faced pallets together; and Continental Diamond Fibre has enlarged its line of fiber-sided skid-boxes.

On the industrial border-line, new types of crane-hoist buckets of greatly enlarged capacities and made of alloy steels, have been brought out by Blaw-Knox, Robins Conveying Belt Co. and Wellman Engineering. Many of these items of equipment will be illustrated and described in later issues of THE IRON AGE.

TOWMOTOR (CLEVELAND) LIFT TRUCKS

STACKING FRUIT BOXES

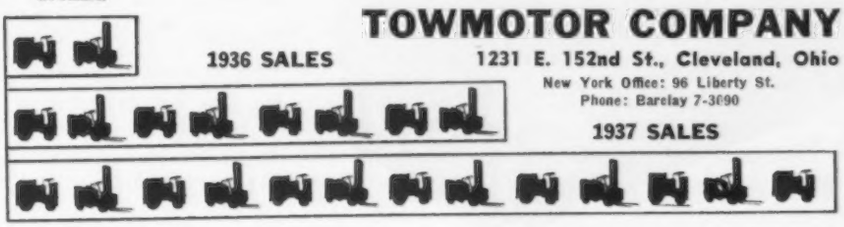
Stacking fruit boxes is just one of hundreds of new Towmotor lift truck applications. Towmotors pick up, transport and stack steel sheets, coils, tubing, forgings, castings and hundreds of other products constantly in scores of plants that keep increasing their fleets with more Towmotors. A major steel company has purchased 52 Towmotors of various types since 1919. A middle Western manufacturer has purchased a total of 38 Towmotors. An Eastern material hand'ing company has built up a fleet of 125 Towmotors. There is a definite reason for such preference in repeat orders for more and more Towmotors. It is the lower cost per year and per ton moved, as well as greater flexibility, endurance, safety and operating simplicity.

Note sales graph below showing increased demand for Towmotors. Over 75% of Towmotor business is in REPEAT orders. The very first Model "C" tractor built is still in service after 15 years' continuous use! Write today for literature and specifications. Then check Towmotor performance records and make your own decision.

1935 SALES

1936 SALES

1937 SALES



TOWMOTOR COMPANY

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. . . make the toughest material handling job seem easy

Truck illustrated made by Baker-Raulang Company

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BATTERIES
With Exide MIPOR Separators
"MIPOR," Reg. U. S. Pat. Off.

READY to serve you are new electric industrial trucks far in advance of older types in capacity and performance. They are production tools of the highest order, able to handle the steel mill's heavy jobs with a new speed and ease.

Also available are batteries especially fitted to power these trucks, able to deliver unflagging performance throughout each working shift . . . batteries that demand so little in return for what they give that during long years of service they keep cutting down handling costs.

These batteries are Exide-Ironclads, which have proved themselves in the steel industry. To sum up the experience of users—*you can't realize what an electric industrial truck is capable of until you use an Exide-Ironclad Battery.* Write now for free booklet, "In Selecting Any Motive Power Battery BE SURE."

THE ELECTRIC STORAGE BATTERY CO., Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

STEEL *Mill* EQUIPMENT

Higher wages, changing labor policies and unprecedented taxes combining to force new advances in production technique. Primary capacity and blooming mills next in order for modernization.

BY THOMAS C. CAMPBELL
Pittsburgh Editor, THE IRON AGE

WITH large scale domestic construction of wide continuous hot strip mills about ended, cold mill installations nearing a zenith, and auxiliary equipment refinements being accelerated, the next year or two will probably usher in final realization of substantial improvements and replacements in primary steel making capacity and blooming mill departments.

Actual expenditures for steel mill equipment in 1937 were about $225,000,000. Although appropriations for 1938 are not as great as those made a year ago, actual outlay in 1938 will not be far below that made in 1937. This will be due to a combination of 1937 projects not yet completed and others that have been recently approved.

Consumer requirements remain the major motivating force behind the rapid changes in the making and shaping of steel. Other factors, however, have entered the picture recently and will have additional bearing on future developments. Higher wage rates, changed labor policies and unprecedented increases in taxes will force operating changes in order to bring down unit costs of making steel products. It is impracticable to add these increases entirely to the selling price of steel nor is such a method regarded as sound or desirable by steel makers.

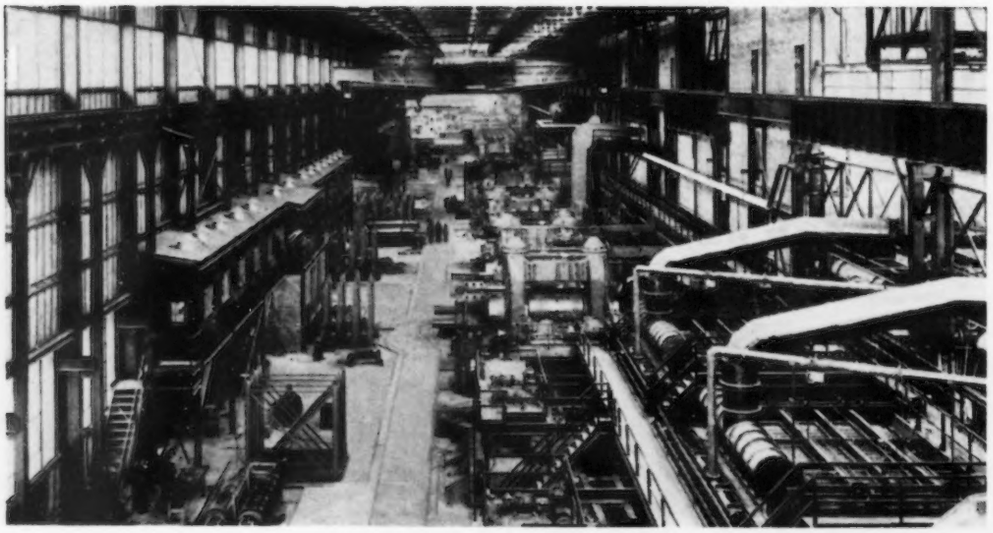
For the first time in at least three years the closing months of the year found no new announcements of wide hot strip mill installations. Three mills announced during the latter part of 1936 are now completed. These include Tennessee Coal, Iron & Railroad Co.'s 48-in. mill at Fairfield, Ala., Republic Steel Corp.'s 98-in. mill at Cleveland, and Bethlehem Steel Co.'s 56-in. mill at Sparrow's Point, Md. Carnegie-Illinois Steel Corp.'s 80-in. mill at Irvin works will be completed about the middle of 1938. Jones & Laughlin Steel Corp.'s 96-in. mill at Pittsburgh went into production early in 1937.

When the Carnegie-Illinois mill now under construction is completed, wide strip and sheet capacity by the continuous method in this country will be about 13,000,000 tons annually. With at least three mills in operation capable of rolling wide plates continuously, it is expected that one more such installation may be made in the not far distant future. Otherwise it can probably be said that the initial cycle of large size continuous strip mill installations for domestic use has ended for the time being.

The building of cold mills, however, continues, and it does not appear that the turning point has yet been reached. Original estimates of cold mill needs were insufficient to meet actual conditions. Contributing to the increase in cold mill installations is the rapid changeover from hot rolled tin plate to a cold reduced product. Another factor has been the increased efficiency of the hot mills brought to light by the unprecedented demand for sheets and strip early in 1937. Some producers lost business because of inability to meet tonnage requirements with delivery desired by customers. A speeding up of accessory equipment combined with further cold mill additions will round out the entire cycle of wide strip and sheet manufacture. Meanwhile, the trend on both hot and cold mills is for increased speed, hence, larger capacities.

Cold Reduced Tin Plate Capacity Increasing

Cold reducing tin plate mills are still being built and the changeover from hot pack method of rolling has



INSIDE the world's largest continuous strip mill, completed for Republic Steel Corp. at Cleveland in 1937. This craneman's view of the 1768-ft. hot mill building shows two of the three heating furnaces in the right foreground. Just beyond them are scale breaker, broadside mill and three roughing stands which are controlled from the pulpit alongside the facing wall. The six 4-high finishing stands are barely distinguishable in the distance, although the structure extends again as far beyond them. This mill will have a rolling capacity of 70,000 tons per month.

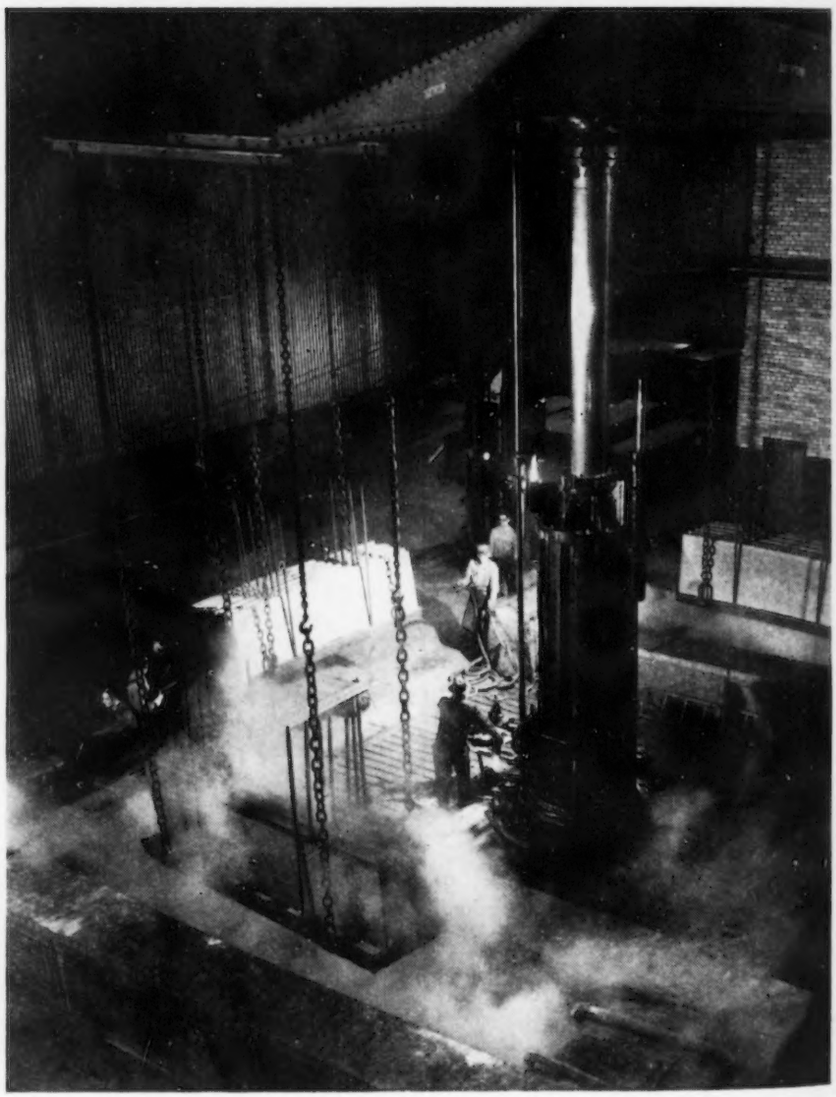
reached the point where cold reduced capacity is now about 52 per cent of the total tin plate capacity of the country. It is expected that in a few years this ratio will be close to 80 per cent. Many producers will retire hot mill equipment as soon as the latest cold mill equipment is fully operating and there is no need for pack rolls now being replaced. The phenomenal growth in the use of tin plate has been such that in the past two years at least all existing mills both hot and cold have been pressed into service at one time or another. Also, the heavy demand for sheets and strip made some of the continuous mill capacity unavailable for tin plate gages at certain times. The table elsewhere in this article shows statistics on hot and cold reduced tin plate.

Non-Integrated Makers May Revamp Equipment

The small non-integrated strip and sheet maker who has neither the money nor the need for large continuous mills is giving his present equipment close scrutiny. Most of these producers intend to retain their place in the flat rolled market. The need for action in revamping finishing mills was postponed during most of 1937 when demand for flat rolled products was such that almost every mill capable of running was pressed into service. Now with demand having receded, competition keener, and costs increased, the situation takes on a different outlook.

One development in the making that is being considered is a small combination continuous hot and cold mill for making sheets and strip of smaller widths than is made on the larger mills. It will probably consist of a roughing stand followed by five or six finishing stands. Disengagement of shears, tables, etc., and a change of rolls will convert the finishing train into a tandem cold mill.

A recent increase in three-high mill



PICKLER installed at a recently constructed continuous mill for pickling sheets.

installations (even by some makers with continuous strip mills), indicates that some sheet producers are using this method in their quest for lower operating costs with acceptable gage and surface. Quite a few of these mills have been sold in this country during the past year for sheet breakdown units and foreign sales have also increased.

The possibility of further developments in the hot Steckel mill is being watched. The three present installations are serving as a proving ground and should additional advances be made, some sheet and strip makers might choose this method of solving their difficulties.

More May Enter Cold Reduced Tin Plate Field

Small non-integrated makers of tin plate are watching with interest the rapid growth in the use of cold reduced tin plate. While there is a good demand for the hot rolled product, some small tin plate makers are considering adding to or changing equipment to enable production of cold reduced tin plate. The combination mill mentioned above may be one answer. The use of cold Steckel mills by the smaller manufacturers is another and some makers are even considering buying cold reduced strip in coil form, with temper passing and tinning to be completed by them.

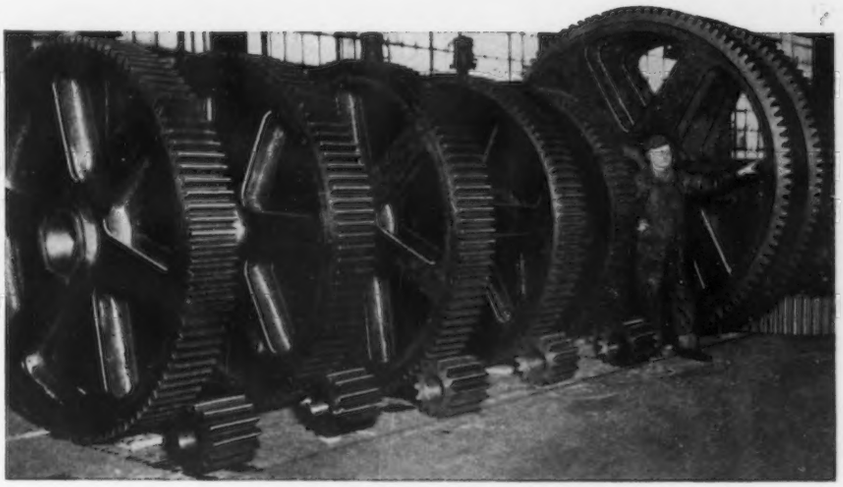
Coincident with contemplated finishing mill changes in plants of the small steel maker are the rapid improvements being made in accessory equipment of the larger strip and sheet mills. For the past few years emphasis has been placed on the speeding up of such machinery as picklers, welders, electrolytic cleaners, etc. Considerable study is being given to interconnecting conveyors between units in wide strip mills. The ultimate goal is a coordinated series of processes resulting in the best speeds and operations which will result in less operating costs with no impairment of quality.

Strip Welding To Make Advances

Considerable experimenting on strip welding machines occurred in 1937. Further refinements are expected in 1938 with a practical certainty that this particular accessory equipment will make an important contribution to flat rolling processes during that year.

The strip welder is an important part of the strip manufacturing cycle, the main object of the welding being

RELIANCE
SOUND
STEEL CASTINGS



Gears in a customer's shop cut from steel castings poured in the Reliance foundry. A few of many gears cast from these patterns—each sound and solid throughout, and all homogeneous.

Gear blanks, the most explored of all castings by machining, are a specialty with Reliance.

In the ordinary types of castings, shrinkage cavities may be undiscovered, but never in gears. Gears must be solid. No short-cuts of any kind may be safely used in their production.

As casting specialists for 38 years, we have put into Reliance gears superior physical properties. Uniform ease of machining is a recognized Reliance quality.

This experience or "know-how" demanded by this type of production certifies that all other Reliance castings are equally sound.

We recommend that you order Reliance "sound" castings. They mean freedom from rejections, lower production costs in your shop, and **uniform heat treating quality.**

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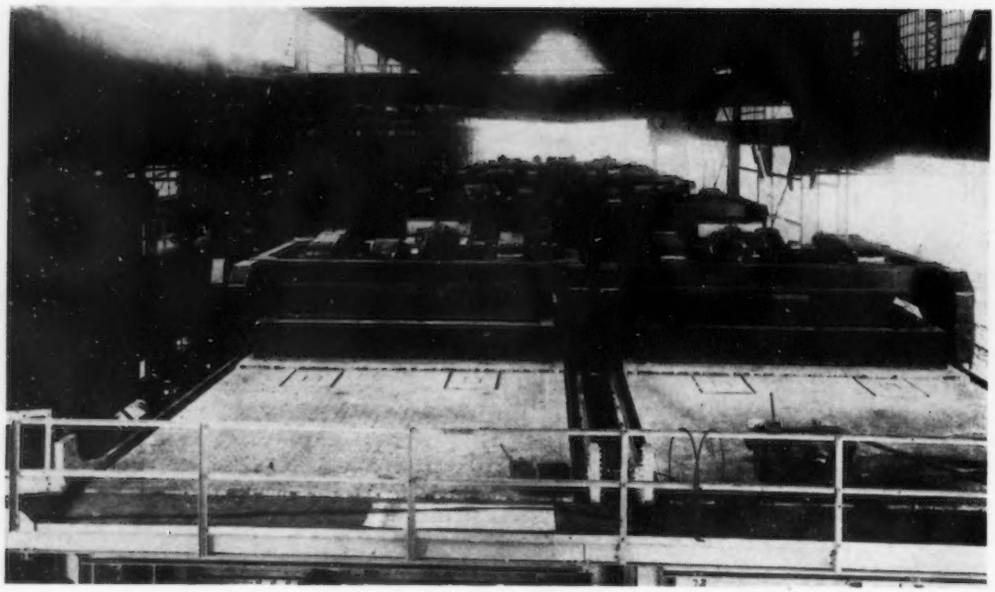


A RECENT installation of the newly designed recuperative soaking pits.

to obtain larger coils. Any substantial gain in speed through improved methods will be immediately reflected in steel finishing costs.

Further improvement in strip welding will result in increased production with another link in the strip manufacturing cycle greatly strengthened. The efficiency of present cold mill equipment will be greatly enhanced because of uninterrupted rolling of larger coils.

Temper Pass Mills

The use of the temper pass mill for cold reduced tin plate, a recent innovation, is growing, and several installations were made during the past year with more to follow. For some purposes cold reduced tin plate must be quite stiff. With the tandem temper pass mill, the desired stiffness can be obtained with a single pass, thus eliminating the necessity of putting the strip through the temper pass mill more than once which at times is necessary when a single stand mill is used.

Continuous Sheet and Wide Strip Mills Installed or Under Construction in the United States With Approximate Capacities

Name of Company and Location of Mill	Year Started	Size, In.	Annual Capacity, Gross Tons
American Rolling Mill Co., Ashland, Ky.	1926	58	432,000
American Rolling Mill Co., Butler, Pa.	1926	48	315,000
Republic Steel Corp., Warren, Ohio	1927	36	302,000
Weirton Steel Co., Weirton, W. Va.	1927	54	420,000
Carnegie-Illinois Steel Corp., Gary, Ind.	1928	42	400,000
American Rolling Mill Co., Middletown, Ohio	1929	80	372,000
Wheeling Steel Corp., Steubenville, Ohio	1929	60	540,000
Great Lakes Steel Corp., Ecorse, Mich.	1930	38	400,000
*Carnegie-Illinois Steel Corp., South Chicago, Ill.	1931	96	720,000
Otis Steel Co., Cleveland	1932	72	375,000
Inland Steel Co., Indiana Harbor, Ind.	1932	79	600,000
Allegheny Steel Co., Brackenridge, Pa.	1932	38	275,000
Youngstown Sheet & Tube Co., Indiana Harbor, Ind.	1934	72	214,000
Youngstown Sheet & Tube Co., Campbell, Ohio	1935	79	600,000
Carnegie-Illinois Steel Co., Gary, Ind.	1935	38	270,000
Ford Motor Co., Detroit	1935	56	500,000
Carnegie-Illinois Steel Corp., MacDonald, Ohio	1935	43	300,000
Bethlehem Steel Co., Lackawanna, N. Y.	1936	79	600,000
Carnegie-Illinois Steel Corp., Gary, Ind.	1936	80	720,000
Great Lakes Steel Corp., Ecorse, Mich.	1936	96	720,000
Granite City Steel Co., Granite City, Ill.	1936	90	375,000
*Carnegie-Illinois Steel Corp., Homestead, Pa.	1936	100	729,000
Jones & Laughlin Steel Corp., Pittsburgh	1936	96	720,000
Bethlehem Steel Corp., Sparrows Point, Md.	1937	56	600,000
Republic Steel Corp., Cleveland	1937	98	720,000
Tennessee Coal, Iron & Railroad Co., Birmingham	1937	48	300,000
Carnegie-Illinois Steel Corp., Pittsburgh	1937	80	600,000
			13,119,000

*These mills are continuous and semi-continuous plate mills, but are capable of rolling heavier gage sheets.

Electrolytic Cleaning Lines Speeded Up

Recent improvements have been made on electrolytic cleaning lines. A speed of 1000 ft. a min. for tin plate gage strip has been approached. Another interesting feature is the electrolytic cleaning of wide material. One unit is now in operation which has handled up to 74-in. strip.

Shears Given Attention

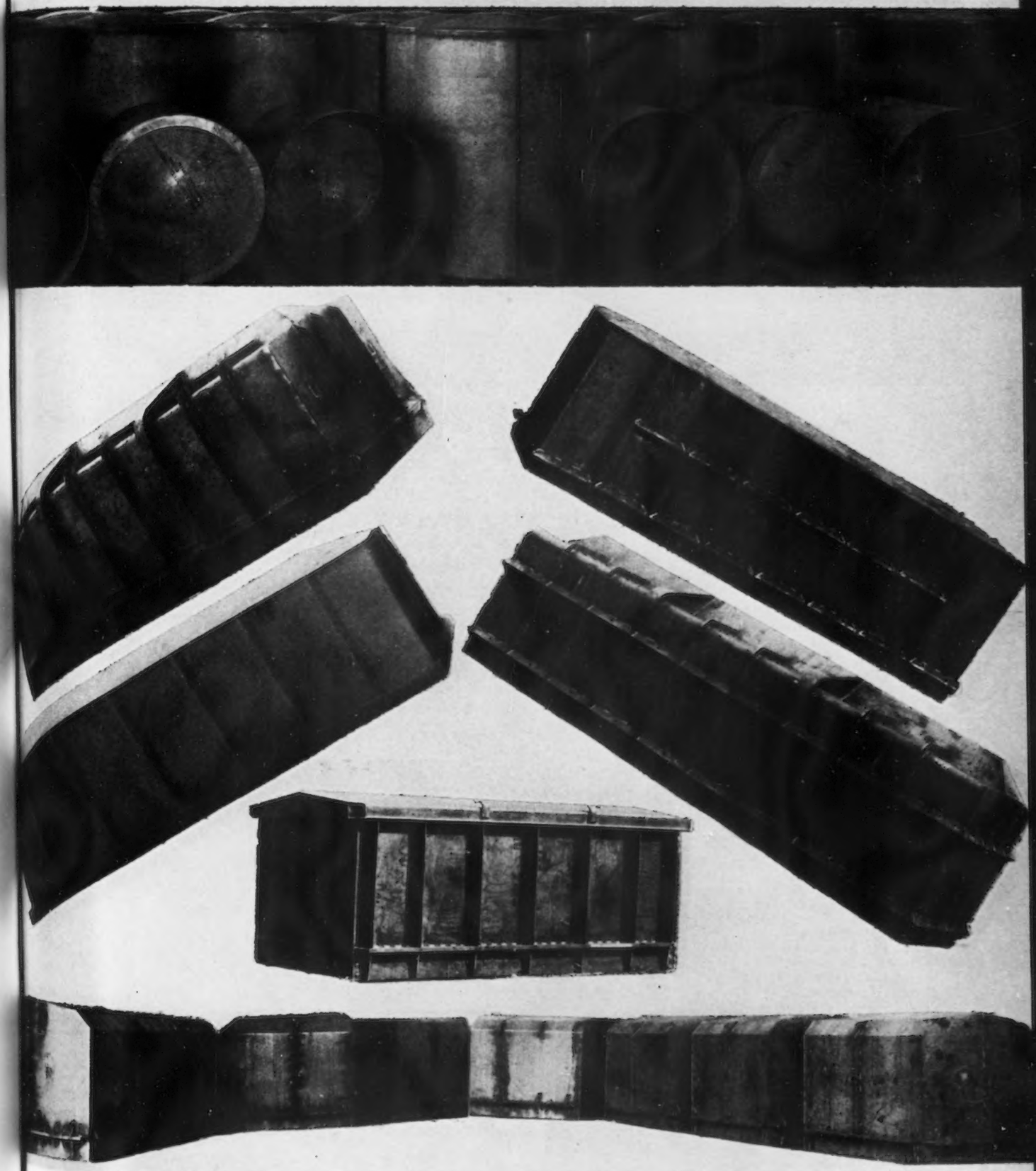
Considerable attention has been given to shearing during the past year, especially in the manufacture of cold reduced tin plate. A new variable crank-type shear has been perfected recently and it is claimed that a speed of 533 ft. a min. has been obtained in the shearing of cold reduced tin plate, with an accuracy of within 1/32 of an in. A synchronized rotary drum-type shear has recently sheared at a speed of 500 ft. a min. with the desired accuracy, according to the manufacturer. The improvement in tin plate shearing has been an important contribution and has resulted in faster production without loss of accuracy.

An improved down and up cut billet and bloom shear has been recently developed. The shear proper consists

STEEL MILL P.I.W. EQUIPMENT

STEEL PLATE CONSTRUCTION

ANNEALING COVERS • TOPS • BOTTOMS
STACKS • TANKS • PIPING • GALVANIZING KETTLES



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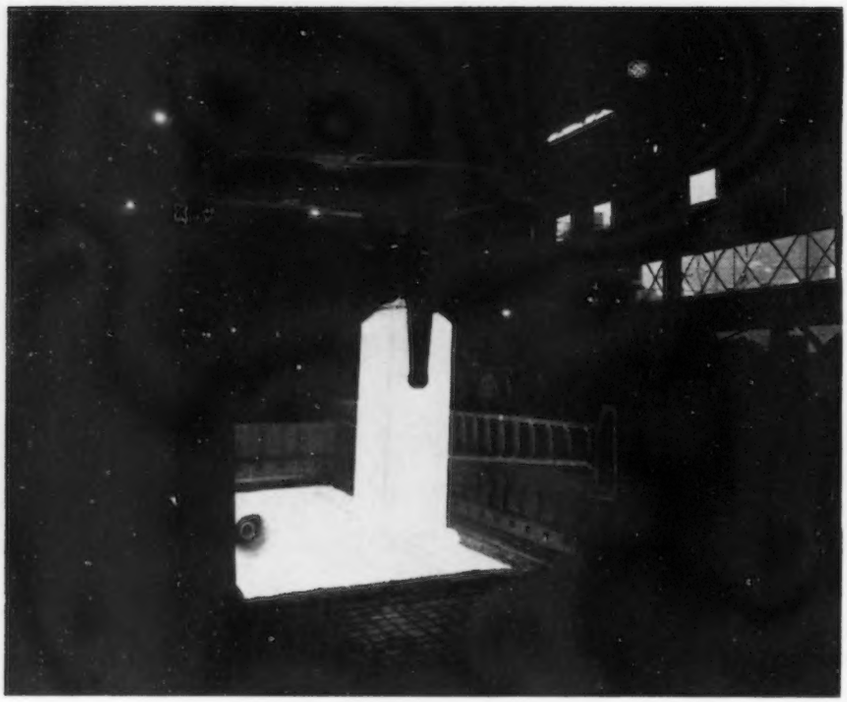


A RECENT installation of one-way fired soaking pits.

of a bottom knife block, a top knife block, a crankshaft center in the bottom knife block, a pin in the top block, and two interconnecting links which absorb all the shearing stresses. A simple frame takes up the external movement. Power is transmitted to the crankshaft from an independently mounted gear drive through a universal spindle.

In operation, the top knife block first descends on the material to be cut, forms a simple gag, and then completes the stroke, while the bottom block pulls itself up.

Other Accessory Equipment Perfected

A 14-ft. long sheet stack transfer conveyor has recently been developed for a Southern strip mill. The unit is designed to receive stacks of sheets and discharge them at right angles on to a processing line conveyor. Stacks weighing approximately 20,000 lb. are handled, with the largest individual sheet being 72 in. wide and 13 ft. long.

Electrical Gages

The principle involved in the electrical gaging of strip, which was developed a few years ago, has been adapted to sheet classifiers and strain gages. The steel sheets are gaged while the material is still in strip form and sorting accomplished after the steel has been cut by a flying shear. There is a definite timing relation between the gaging units and the sorting mechanism whereby the time delay between the gaging and sorting of sheets is synchronized with the speed of the shear. With this device, it is possible to separate automatically or classify oversize, acceptable and undersize material. A modified sorting unit has also been designed for application on longer sheets which are cut to length before gaging and sorting.

The same principle used on sheet classifiers has been adapted for measuring roll pressures. In principle this instrument known as the strain gage is based on the fact that as pressure is exerted on the mill by screw down, the housing will stretch in a relation which is directly proportional to the pressure. This stretch is measured and converted so that the pressure may be read directly in pounds on indicating and recording instruments.

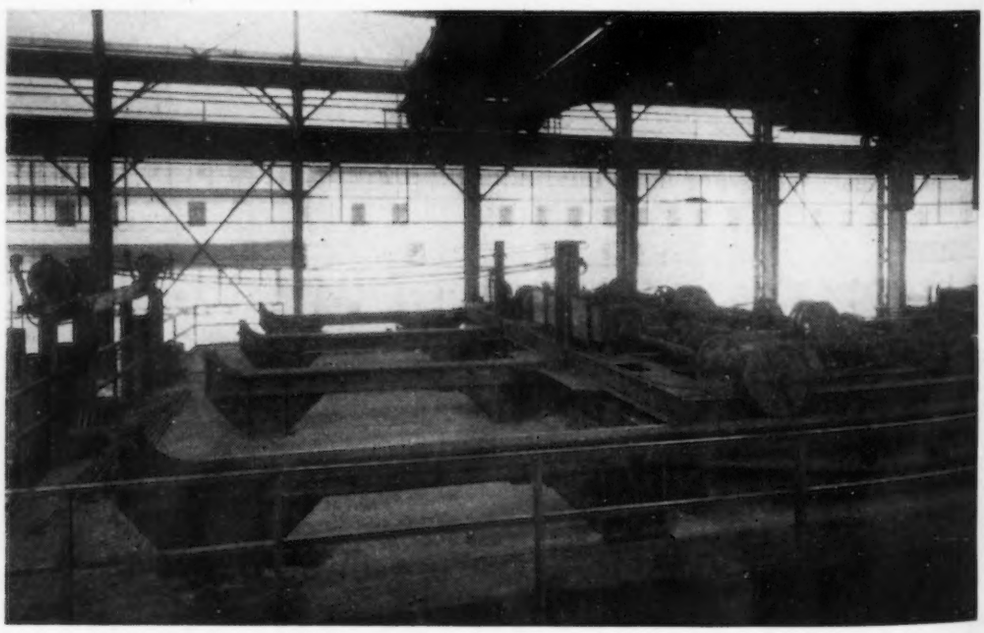
Rotary Pickler

Recently developed is a rotary pickler now operating at a small steel

o o o

THE regenerative soaking pits have been improved upon to meet current demand for automatic control of atmosphere, heating and pressure.

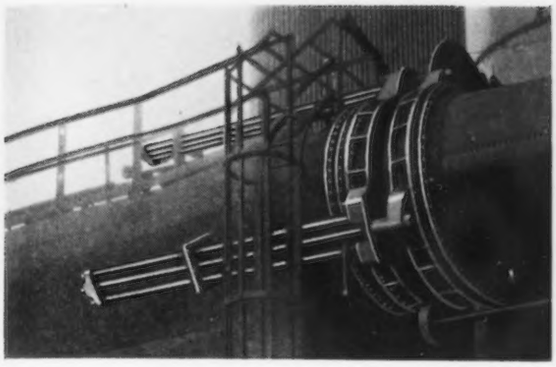
o o o



BAILEY...

BLAST FURNACE EQUIPMENT

1 The Thermal Expansion Goggle Valve



This illustration shows a 72"x60" Thermal Expansion Goggle Valve in the clean gas main between blast furnaces and central boiler house, Weirton Steel Company, Weirton, W. Va.

No gas escapes to atmosphere when plate is swung to opposite position.

2 American Mechanical Valve with Totally Enclosed Goggle Plate

3 The American Open Joint Checker for Blast Furnace Hot Blast Stoves

4 The American Cold Blast Valve

5 Blast Furnace Blow Off Valve

6 The American Safety Cinder Notch Stopper

7 Vreeland Pug Mill Equipment for Blast Furnace Dust Catcher

8 American Water Metering Method for Blast Furnace Skip

9 American Mixer and Check Relief Valve

10 The American Steel Bottom for Blast Furnace Hot Blast Stoves

11 The American Chimney Valve

12 Blast Furnace Mixer and Drop Valve

13 American Globe Strainer

14 American Sintering Plant Pug Mill

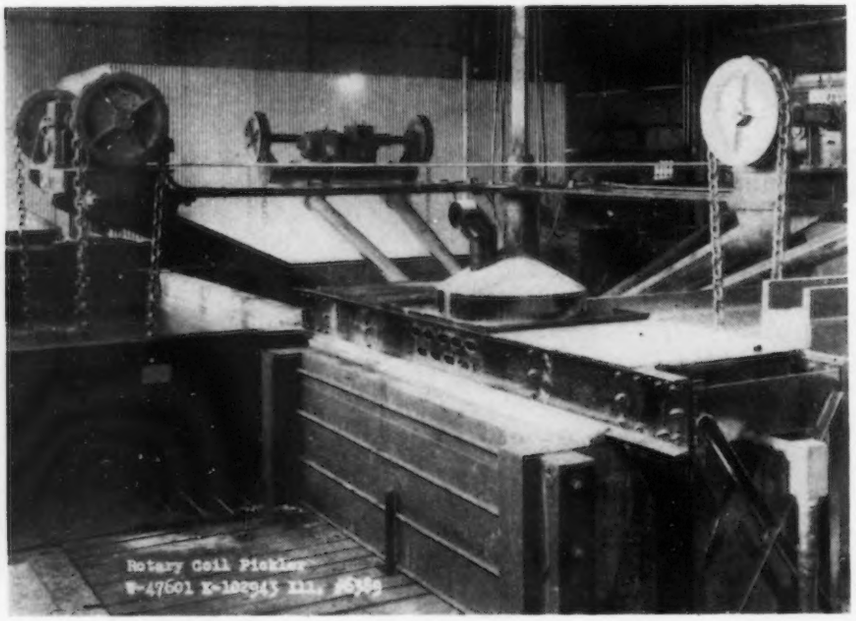
15 American Pig Releaser for Pig Casting Machines

16 American Gas Seal for Gauge Rods

17 "Superior" Checker for Regenerative Furnaces

WILLIAM M. BAILEY COMPANY

MAGEE BUILDING **ENGINEERS** PITTSBURGH, PA.



ROTARY pickler used in handling coils in small steel plants. Mandrels with coils are immersed in acid water and oil.

plant. The mechanism has four mandrels. In the first position the arm is loaded with the coil which has been loosely coiled so that liquids can reach all of the surface. In the second position the coil is lowered with the mandrel into an acid bath. The acid is forced through the bath under pressure so that all surfaces are reached. During this operation the mandrel turns the coil with it. From the second position the mechanism is raised and the coil carried to the next position and lowered into a bath of water. In the fourth position the coil is lowered and completely covered by oil, the liquid being forced through pressure the same as in the other baths. In this description only one coil is mentioned, whereas in actual practice all four mandrels are loaded and it has been recently found that it is possible to handle two coils at a time on each mandrel.

Originally developed for cold reduced tandem tin plate mills, a belt wrapper has been further perfected for use in connection with wider mills and heavier strip. This device is for starting the end of a strip coming from a delivery unit on to a tension reel without the necessity of entering the end of a strip into a gripper on the reel head.

Motorized Wrenches

Developed by the engineering department of a Mid-Western steel plant are motorized socket wrenches for setting the rolls on rod mills. This application of a motor drive for operating screw downs to replace the usual hand power wrenches commonly used results in the speeding up of the time of setting the rolls in these mills. This mechanism is attached to 10-in. rod mills and to a 15-in. roughing mill. Final adjustments of the rolls are still made with hand wrenches.

Primary Steel Making Capacity Due for Revamping

There seems to be little doubt that substantial improvements in primary steel making capacity will occur during the next few years. Some large projects had been scheduled for 1937 but for one reason or another have been postponed.

Open-hearth construction during 1937 was not as great as had been anticipated. Two reasons were probably responsible for this condition. One was the urgent need to expend available cash for new rolling mills and other finishing equipment in order to hold positions in the steel market. Another reason is that some companies have held back on open-hearth construction projects in the hope that

HOT AND COLD REDUCED TIN MILL PRODUCTS CAPACITY BY COMPANIES IN ANNUAL NET TONS

	Hot Mill			Cold Mill			
Company	Capacity	Per Cent of Total	Present Capacity	Under Construction	Total	Per Cent of Total	Total
Carnegie-Illinois Steel Corp.	900,000	68	313,600	112,000	425,600	32	1,325,600
Bethlehem Steel Co.	246,000	46	291,000	None	291,000	54	537,000
National Steel Corp.	82,000*	16	422,000	None	422,000	84	504,000
Republic Steel Corp.	117,000	37	198,000	None	198,000	63	315,000
Wheeling Steel Corp.	None	..	240,000	None	240,000	100	240,000
Jones & Laughlin Steel Corp.	134,000	53	121,000	None	121,000	47	255,000
Tennessee Coal, Iron & Railroad Co.	None	..	None	224,000	224,000	100	224,000
Youngstown Sheet & Tube Co.	72,000	33	144,000	None	144,000	67	216,000
McKeesport Tin Plate Co.	201,600	100	None	None	None	..	201,600
Inland Steel Co.	None	..	140,000	None	140,000	100	140,000
Continental Can Co.	123,200	100	None	None	None	..	123,200
Granite City Steel Co.	84,000	72	33,000	None	33,000	28	117,000
Follansbee Brothers Co.	65,000	80	16,000	None	16,000	20	81,000
Columbia Steel Co.	33,600	100	None	None	None	..	33,600
Washington Tin Plate Co.	31,500	100	None	None	None	..	31,500
Total	2,089,900	48	1,918,600	336,000	2,254,600	52	4,344,500

* Estimated by THE IRON AGE.

Note: The above chart constructed from latest available information. No important changes are likely to occur for the next six months at least.

CONTINENTAL

CONTINENTAL 48 IN. BLOOMING MILL TABLES AND MANIPULATOR

Rolling Mill Machinery	Steel and Alloy Steel Castings
Universal Mills	Steel and Alloy Steel Rolls
Blooming Mills	Iron and Alloy Iron Rolls
Billet Mills	Direct-Fired Annealing Furnaces
Bar Mills	Universal Industrial Gas Burners
Strip Mills	Annealing Covers
Non-Ferrous Mills	

CONTINENTAL ROLL & STEEL FOUNDRY CO.

CHICAGO, ILL. PITTSBURGH, PA.

new fundamental developments in design would present themselves.

Thus in a sense there is tremendous potential demand for new primary steel making capacity. It will undoubtedly come to a head relatively soon as most steel companies will, by the next few years, be in a position adequately to take care of market requirements with reference to finished steel and will be able to concentrate on steel making capacity improvements.

Of interest during the past year was the installation of a large bessemer converter within the open-hearth department of a steel plant for the purpose of duplexing steel. The feature of this undertaking is twofold. First, by locating the converter within the open-hearth plant, considerable time and money is saved by speedier handling, there being no necessity for moving hot metal from the bessemer department to the open-hearth department. This latter procedure is the one followed at most mills where duplexing is part of the regular steel making practice. The second point is that of recent years duplex steel has become widely accepted as not only a good steel, but one that takes its place alongside of open-hearth steel made by the scrap method.

At least two steel companies have under consideration the construction of new open hearth plants where the duplex method of making steel will be a regular practice. There is a good possibility that the location of the open hearths and bessemer converters may follow the plan described above.

Blast Furnaces

During the past year two blast furnaces were completed and two more are under construction at the present time. Additional furnaces probably will not be built for the next year or two. Many steel companies are completely modernizing and rebuilding present furnaces with the object of increasing capacity. Obsolete blast furnaces which are too far gone to be rehabilitated are being rapidly scrapped.

In conjunction with the emphasis on improvements in primary steel making capacity is the marked increase in the number of new soaking pit installations. All pits being made at the present time, whether they be regenerative, circular, one way fired, or the recently designed recuperative pit, have three prime characteristics: first, complete control of atmospheric

MODERN MILL TABLES

Special pipe handling table recently installed in a large steel mill.

We are manufacturers of all kinds of handling tables for steel mills.

We also manufacture all types of pipe and tube mill machinery

TAYLOR-WILSON MFG. CO.
Department 3A
McKees Rocks, Penna.
(Pittsburgh District)

A RECENTLY installed electrolytic clean- approach 1000

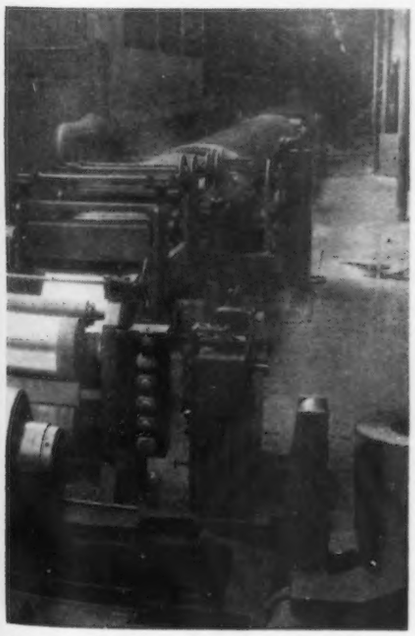
conditions; second, complete control of temperature; and third, the ability to heat ingots uniformly.

A large installation of circular soaking pits made during the latter part of 1936 has been in operation long enough to present a case for its advantages. It is claimed that a check-up on maintenance cost, including brick work repairs, after eight months of operation, was slightly under 1½c. a ton of ingots rolled. Another installation shut down after eight months of continuous operation cost $560 for total repairs and the furnace was only down a period of two days. Another instance is given by the company of a large installation where no repairs were made to furnace covers after eight months of service.

On the one way fired pits, for which low fuel consumption, adaptability to all types of fuels and great ingot capacity for a given space are claimed, the outstanding feature according to the manufacturer was a 1937 installation using straight blast furnace gas as a fuel with the heating speed equal to that of pits using straight coke oven gas, and with a B.t.u. fuel consumption but little exceeding the coke oven gas fired pits.

The recently designed recuperative pit has gained ground in the past year and at least 37 have been installed, having a total heating capacity of over 3,000,000 tons per year. The maker of this pit emphasizes the importance of soft diffusion flame heating with no obstruction to the natural and initial development of the combustible movement. Adaptability to a wide range and conditions and variety of fuels is effected by a system of full automatic control with special provisions for selective variation and adjusted treatment of special grades of steel. A series of these pits in one steel plant is being operated exclusively on cold blast furnace gas, heating a variety of grades with a material proportion of cold steel.

Makers of the regenerative pits, realizing the trend toward the use of blast furnace gas and other lean fuels by steel plants, have modernized their soaking pits to provide selective control and greater flexibility. These new regenerative pits are fully automatic with controls for reversing, combustion, temperature and internal pressure. Capacities have been increased and the fuel rate has been reduced beyond the original expectations. A considerably larger number of regenerative pit installations have been made during the past year than might be supposed.

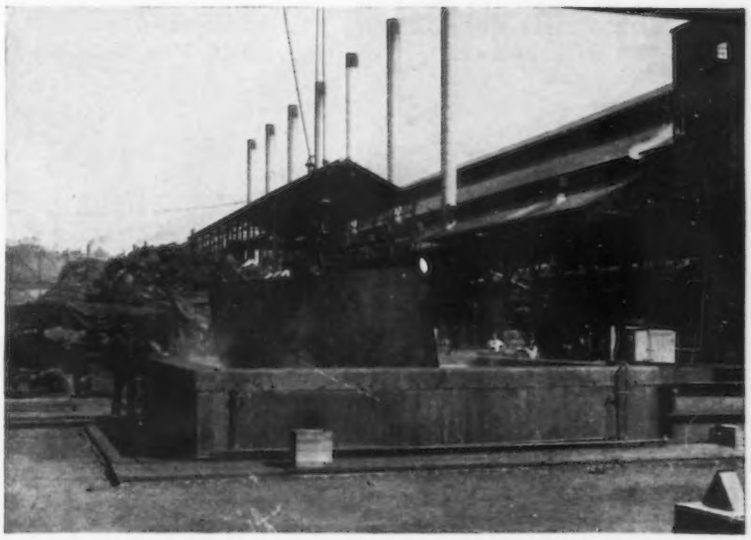


ing line. Speeds on this equipment now ft. a min.

CEILCOTE

TANK LININGS

Reduce Costs • Stop Leaks



THIS welded steel tank 22′ square, 6′ deep is lined with CEILCOTE and acid brick sheathing jointed with acid-proof mortar.

The tank illustrated is out in the open and has been in continuous operation for 6 years without any repair expense whatsoever, and is only one of hundreds of tanks lined by the CEILCOTE method.

Installations are supervised by engineers who have years of practical experience with pickling tank problems, floors, drains and pits.

Complete details furnished for lining tanks of wood, steel, concrete and brick construction.

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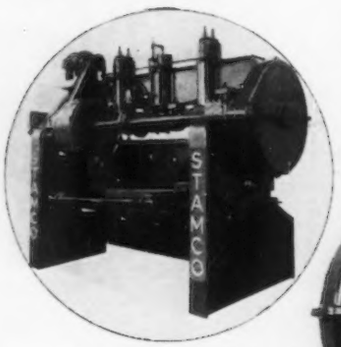
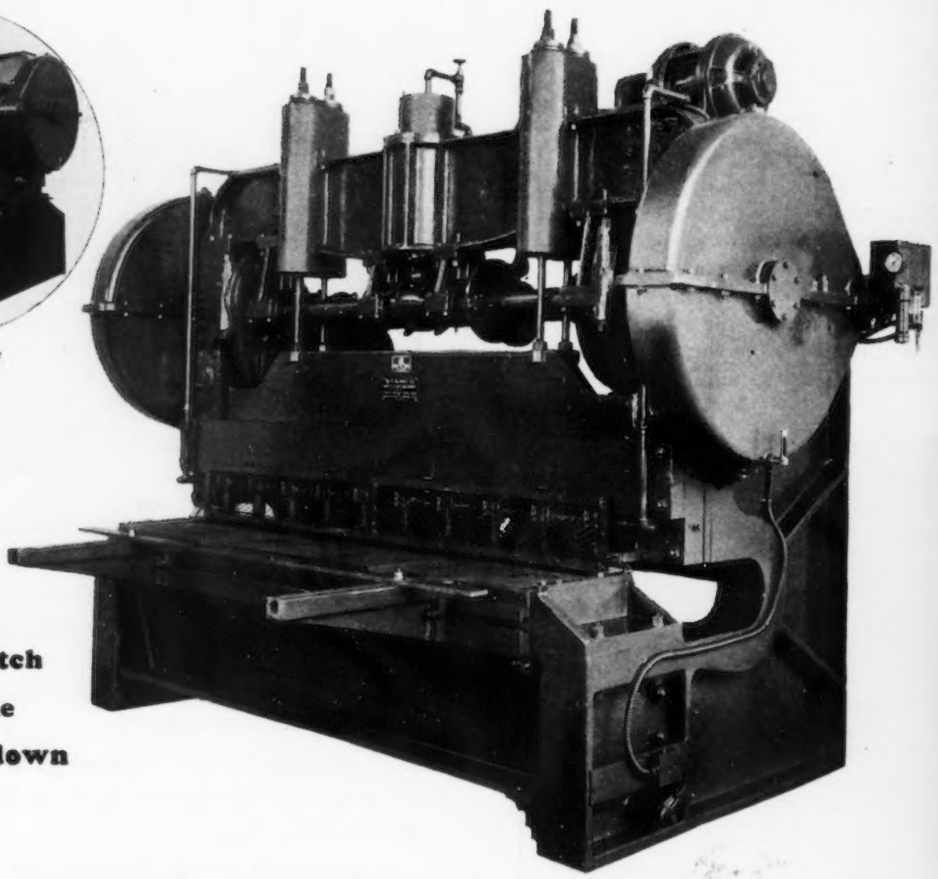


REAR VIEW



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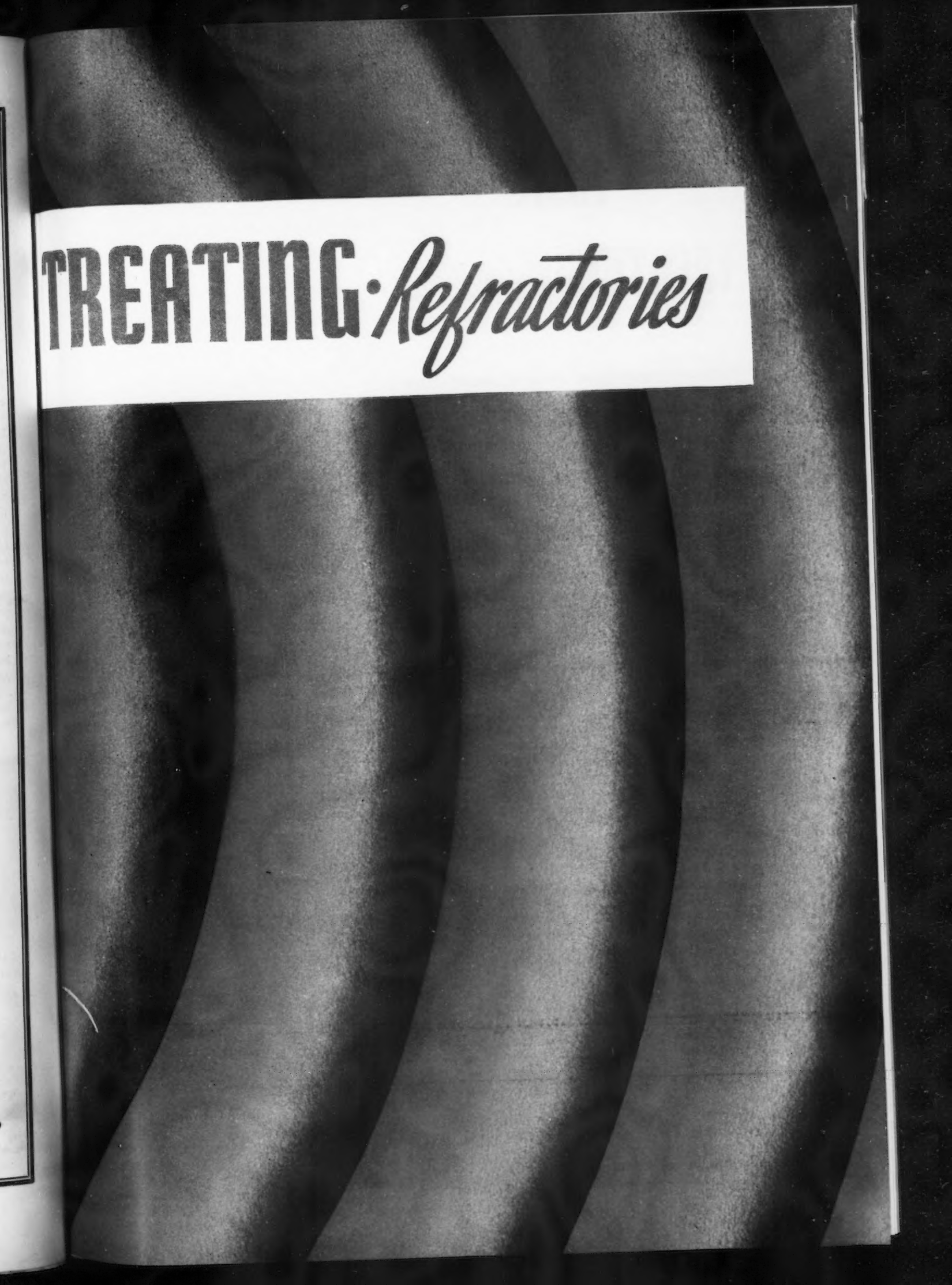
Automatic Brake
Hydraulic Holddown
Twin Drive

We can furnish Shears in Welded Steel, Cast Steel or Semi-Steel Construction, Mechanical Holddown, Hydraulic Holddown, Friction Clutches, Electric Back Gauges

THE STREINE TOOL & MFG. CO.

NEW BREMEN, OHIO


TREATING: Refractories

HEAT TREATING: *Refractories*

Heat treatment and cementation broadened by development of three new alloys and by refinements in atmosphere control.

o o o

BY T. W. LIPPERT
Metallurgical Editor, The Iron Age

o o o

NEATLY placed between two fires, the average heat treater often has cause to bemoan his unenviable position. On the one hand he is forced to work with only those alloys the steel mill metallurgist gives him, and no amount of skill or hocus-pocus will develop properties in the steel not already inherently there when it left the mill. But, on the other hand, the steel treater's customer too often demands low prices, quick delivery and a combination of physical properties well nigh impossible to meet. For these reasons the steel treater constantly has his hands extended for each new offering of the steel mill metallurgist—for every steel developed means one additional tool which may facilitate the meeting of exacting customer specifications.

The past year witnessed the exploitation of three new types of alloys, each amenable to moderately simple heat-treating cycles, and each capable of developing impressive physical properties, which should assure them secure niches in the current industrial picture. Thumbnail sketches of the three steels, their composition, treatment and properties, follow:

Cr-Mo (4120) Carburizing Steel:

Springing from the laboratories of Climax Molybdenum Co., a new chromium - molybdenum carburizing steel (unofficially known as SAE 4120) has already been made in large quantities by the Carnegie-Illinois Steel Co. for use in the automobile industry. The grim insistence of the automobile companies for lower steel prices in the face of rising costs for basic materials was probably the primary incentive for developing the Cr-Mo carburizing steel. The new alloy costs considerably less than the bulk of high-grade carburizing steels, but, none the less, the core properties of the former are about on a par with those of the latter. The new steel analyzes 0.20 carbon, 0.54 to 0.80 manganese, 0.016 to 0.012 sulphur, 0.25 to 0.29 silicon, 0.83 to 0.88 chromium and 0.22 to 0.24 molybdenum; it is available on a tonnage basis, and the attributes claimed are as follow: low initial cost; it can be quenched from the box with minimum, uniform distortion; it takes a very hard, wear-resistant case; it develops good core properties; and it has excellent machineability.

Like all molybdenum carburizing steels, the new 4120 grade is said to respond well to ordinary shop carburizing practice with a minimum predictable distortion. Also, tests have shown that distortion in a variety of differently shaped parts is so slight that negligible finish grinding is necessary, even when working with narrow tolerances. The hard, wear-resistant case is the result partly of the comparatively little untransformed austenite retained in the case, and, also, partly because of the presence of hard, wear-resistant carbides. Note, however, that proper carburizing temperatures are said to prevent excessive grain boundary carbides. That the case depth is very uniform is demonstrated in Fig. 1.

Furthermore, an examination of the data in Table I shows that the physical properties of the 4120 steel are quite desirable. Various sections of the steel

were heat treated, and in each case one set of specimens was direct quenched, and the other pot cooled and reheated. Since the figures in Table I are averages, they may be considered as normal expectancy under ordinary mass production conditions.

Graphitic Steel:

There are many fields where a metal combining the free machining qualities, high resistance to wear and good frictional properties of cast iron, with the uniformity, ease of hot or cold working, ready response to heat treatment, and good physical properties of steel, would be of value. This is particularly true of the die industry. A new graphitic steel developed by Timken Roller Bearing Co. apparently combines these qualities, and is now available for both water and oil hardening applications in the die field.

As rolled, but before preliminary heat treatment, graphitic steel is a hypereutectoid material composed of pearlite and free cementite with the possible appearance of finely divided free graphite. Ordinarily only approximately 20 per cent of the total carbon will appear as free graphite in the steel in this condition, dispersed so finely throughout the steel that no pockets or definitely defined graphitic areas will be noticed.

The high silicon content of the steel renders the carbide phase unstable, allowing the cementite to be broken down into ferrite and free graphite. For most machining operations, graphitic steel is normalized and annealed. This reduces the combined carbon and precipitates part of the total carbon in the form of graphite, uniformly distributed in minute pockets throughout the steel. The pearlite typical of an annealed structure is spheroidized to the degree normally associated with good machining qualities. Experience has indicated that this material machines practically as easily as gray cast iron.

Two types of graphitic steel are now being made. That used for water hardening applications is known as Graph-sil. For oil hardening applications, or where distortion must be held to an absolute minimum and where special toughness is required for the service, approximately 0.25 per cent of molybdenum is added to the specification, this steel being called Graphmo. Preliminary and final heat treatments depend upon the application for which the steels are to be used.

Care must be exercised in the processing of graphitic steel to control graphitization, for once the graphitic pockets are established they are permanent unless forged together. The degree of graphitization can, however, be largely controlled by the annealing treatment. Consequently, material which is to be forged to shape is worked from the as-rolled condition, where a high percentage of combined carbon exists, in which state it can be hot worked very satisfactorily if reasonable care is exercised in keeping the temperature of the piece between 1700 deg. and 2000 deg. F.

Speed Treat:

Following the development of Speed Case, an open-hearth steel of high physical properties and excellent machineability ratings, the Monarch Steel Co. during the year introduced Speed Treat, a similar steel with higher carbon (0.40 to 0.50, carrying the number X-1545), which approaches SAE 1112 bessemer steel in free machining and has a tensile strength of 110,000 lb. per sq. in. The Speed Treat steel X-1545 is said to lend itself readily to heat treatment, so that the best of its inherent physical properties can be developed, yet it is claimed that the user has available a product which machines considerably more readily than many other steels of the same carbon content.

Controlled Atmosphere

Notwithstanding the type of steel used or the process, the average steel treater at one time or another is very conscious of the atmosphere surrounding his product during treatment, too often because of a ruined batch of expensive steels. There has been a great mass of information and misinformation dealing with gaseous atmospheres for various heat treatments and for various metals, and despite this plethora of data there is little in the way of common practice among steel treaters. Individual plants often devise special atmospheres, and most frequently this special gas is credited with many and broad claims of excellence.

But all who have devoted most attention to the controlled atmosphere problem have in mind the minimization of chemical change in the surface of the steel (which, of course, is not

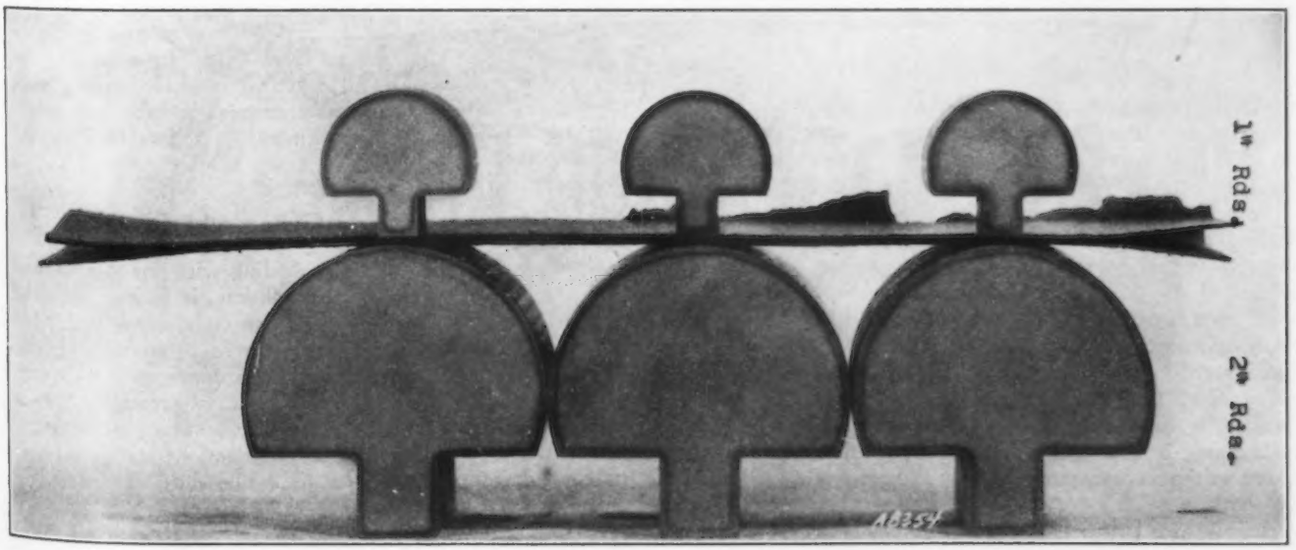


FIG. 1—Series of specimens simulating gear teeth, showing uniform depth of carburizing for the 4120 chromium-molybdenum steel. The samples on the left were pot cooled, those in the middle oil quenched at 95 to 105 deg. F., and those on the right pot cooled, oil quenched and reheated.

true in the case of carburizing, nitriding, etc.). To have the steel leave the treating chamber chemically the same as when it entered necessitates a continuous state of equilibrium between the elements of the steel and the composition of the surrounding atmosphere. Therefore, any study of this problem must take into account (1) the composition of the steel, (2) the composition of the atmosphere, and (3) the temperature range during the heat treatment.

These problems in general, and particularly the problem of bright hardening of tools, have been covered with no little skill in one investigation during the year.[1] The investigators pointed out that dissatisfaction with the scaling and decarburizing which inevitably occurs to some extent when heating high carbon and alloy steel tools, dies, springs and the like prior to quenching is responsible for the considerable study of furnace atmospheres for protecting these materials. Scaling, it was pointed out, is caused by oxygen, carbon dioxide and water vapor in the furnace atmosphere; and wet hydrogen, carbon dioxide and water vapor may also cause decarburization. In general hardening practice, an oxidizing atmosphere is now often favored, for the scale produced on many steels acts as a protective layer, hindering decarburization. When an endeavor is made to produce a synthetic atmosphere suitable for bright-hardening, the difficulty at once arises that the carbon and alloy content of steels has a very great influence on their behavior and, at the same time, the action of any atmosphere depends on the temperature.

At 1200 deg. F., for instance, an atmosphere of carbon monoxide mixed with 56 per cent of carbon dioxide is neutral to 0.1 and 1.5 per cent carbon steels equally. At 1650 deg. F., however, the mixture must not contain more than 19.5 per cent CO_2 otherwise it will oxidize 0.1 per cent carbon steels, and if 1.5 per cent carbon steels are to be treated only 2 per cent carbon dioxide can be tolerated. The open-fired gas furnace, arranged to give a flame having no carbon monoxide and little free oxygen has in the past, according to the investigators, proved as satisfactory a heating medium as any, and a gas of a similar composition to that produced in these furnaces, and made by partially burning fuel gas, is often supplied to electric muffle hardening furnaces. Some scale and decarburization nearly always occur with these atmospheres, however.

The best commercial results appear to be obtained with a natural raw hydro-carbon gas, but slight modifications are necessary with different steels. The raw gas, for instance, is neutral to 1 per cent carbon steel, carburizing to straight-chromium steel, and decarburizing to 1 per cent carbon steel containing tungsten. A study of the effects of typical commercial protective atmospheres on higher carbon steels has recently been undertaken by the Battelle Memorial Institute, and a preliminary report was published near the middle of the year[2]. It was shown that the loss or gain of weight of clean steel specimens after heating in various gas mixtures could be taken as a measure of carburization or decarburization. The results make it clear why bright-hardening is so much more difficult than the bright-annealing of low-carbon steels, when almost any reducing gas mixture will serve. At the higher temperatures used in hardening, attempts to reduce scaling by increasing the carbon monoxide and hydrogen without removing carbon dioxide and, in particular, water vapor, involves risk of severe decarburization. It is essential to avoid these two constituents or to remove them by purification methods if good bright-hardening work is to be done. If these are absent, bright-hardening is possible in mixtures of carbon monoxide, nitrogen, and hydrogen, according to the investigators, and additions of methane may be made to counteract the decarburizing effects of carbon monoxide and hydrogen, according to the composition of the steel. Additions of methane may occasionally allow atmospheres containing a little carbon dioxide or moisture to be used, but both mixtures may attack furnace parts. Definitely, it is stated, carburizing gases, such as cracked fuel gases or oils may be found practical when hardening such parts as transmission gears on which a very thin carburized surface may be permitted.

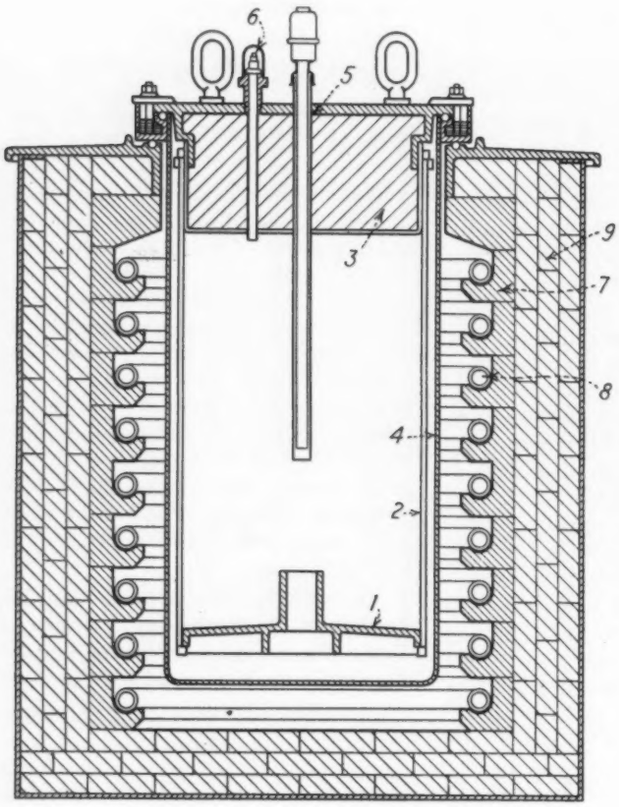


FIG. 2—The Grünewald bright-annealing equipment: (1) cast base plate; (2) nickel-chromium suspension rods; (3) thermally insulated cover; (4) light Grünewald annealing pot; (5) pyrometer sheath; (6) valve; (7) firebrick lining; (8) heating element; and (9) thermal insulation.

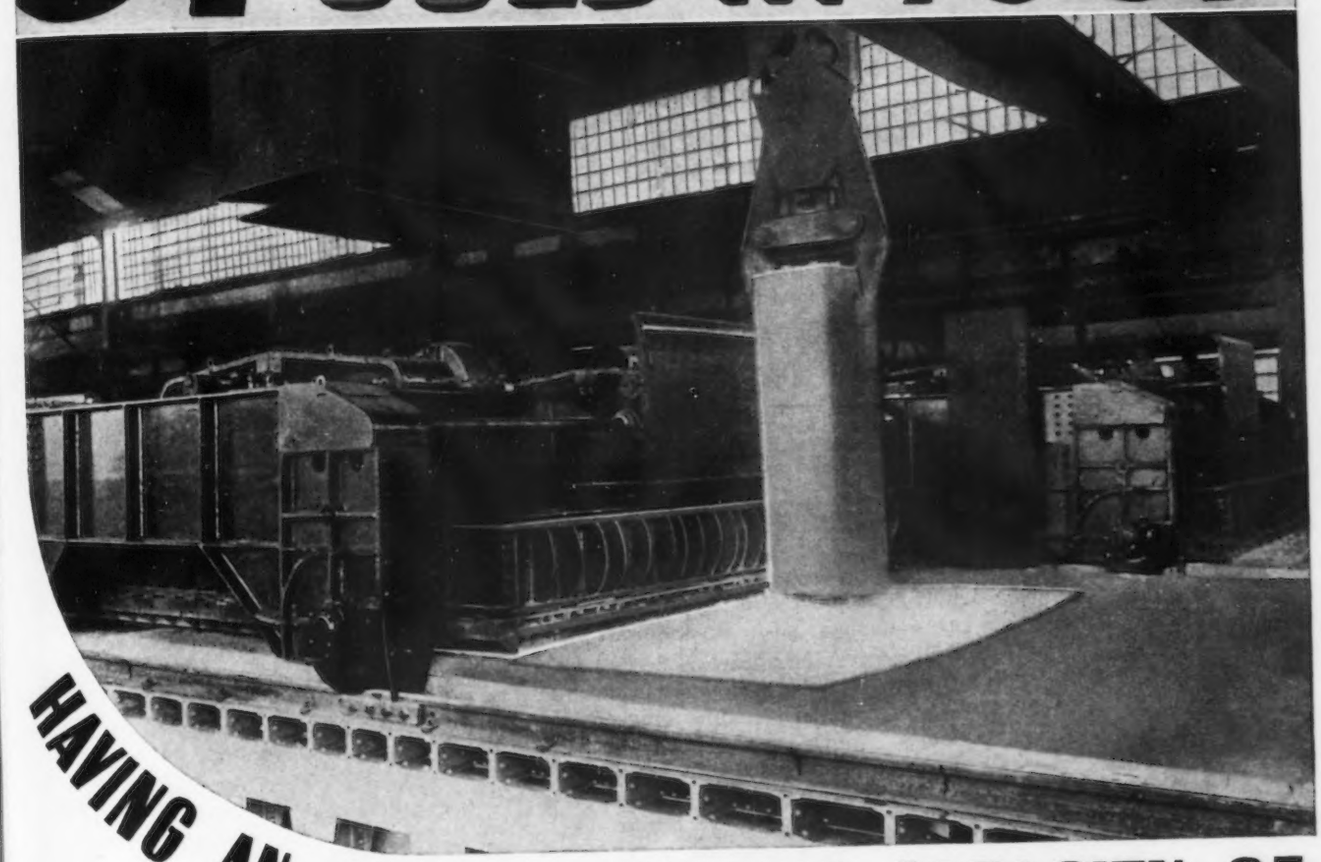
Grünewald Process

While dealing with the use of furnace atmospheres, it is interesting to note that the Grünewald bright-annealing process used on the Continent has been converted to the use of a slight positive pressure of artificial atmosphere. The process originally was an ingenious method of preventing oxidation without the use of an artificial atmosphere by applying the principle of the fruit preserving jar to the electric annealing furnace.

[1] Metal Progress, September, 1937, p. 240.
[2] Metals and Alloys, June and July, 1937.

The AMCO PIT FURNACE

37 SOLD IN 1937



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Experience has shown, however, that in certain applications advantages are obtained by the use of artificial atmospheres, and the modified process and its application to a number of metals have been described by S. V. Williams.[3]

The essential features of the Grünewald electric furnace are shown in Fig. 2. The charge, strip or wire in coils, is stacked on the cast base plate, which is suspended by nickel-chromium rods from the thermally insulated head. The charge is lowered into a light-weight pot and a perfect seal established at the top by means of a rubber ring which is water cooled. The pot is lowered into a vertical cylindrical furnace which has a reduced diameter throat which effectively precludes injury to the heating elements. Note that the pot is simply an outer envelope and does not carry any weight of the charge. Thus it can be made of light gage metal, usually of nickel-chromium steel.

The success of the process depends on a really effective seal obtained by the use of the water cooled rubber ring. During the heating period, the valve is set to blow off at a pressure slightly above atmospheric so that as the pot and contents are heated, air escapes through the valve, and at annealing temperature there is practically no atmospheric oxygen in the pot. During cooling, the valve closes and the charge cools in a partial vacuum. Both ferrous and non-ferrous products are treated in such a furnace.

When an atmosphere is substituted for the partial vacuum, it has been found that because of the perfect sealing device, it is possible to limit the total volume of gas per charge to a relatively small amount, and, thus, when the work demands it, the use of an expensive gas, such as cracked ammonia, can be made an economic proposition. The artificial atmospheres can be used in different ways. Thus the pot can simply be purged of air, the original process with the final cooling under a partial vacuum then being carried out. Under these conditions, only about 10 to 15 times the volume of the free space inside the pot is required. In practice this would amount to 50 to 200 cu. ft. of gas per charge, depending on the size of the pot and the nature of the charge. Alternatively, the pot may be purged and a flow of gas maintained during the heating period. This latter method is useful when it is desired to remove vaporized rolling lubricants from the pot as soon as possible. The charge may be cooled under a partial vacuum or with the pot connected to the gas supply, so as to maintain a flow or a slight positive pressure.

A cheap atmosphere, such as partially burnt coal gas, is blown to waste. Similarly with cracked ammonia, which is used when the material being annealed calls for a perfectly dry and oxygen-free gas, but it is usual only to use the comparatively small volume required to purge the pot. With burnt ammonia, a circulating and regenerative plant would be used. The Grünewald furnace is ideal for use in conjunction with this type of plant since the ammonia make-up can be determined accurately and maintained at a low value with the result that the gas cost is very low.

One indirect advantage of the modified process over the standard Grünewald process, is the reduction in the number of pots per furnace. The development of a partial vacuum with the standard process results in a fairly long cooling period. When, however, an artificial gas atmosphere is maintained within the pot during cooling, the heat is transferred from the charge to the pot envelope by conduction through the gas and also by means of the natural convection currents set up. These effects result in a substantial reduction in the total cooling time and consequently in the number of pots, which is determined by the relation between the heating and cooling times. This is naturally reflected in the first cost of the plant.

[3] Metal Treatment, fall edition.

TABLE I

Physical Properties of 4120 Cr-Mo Carburizing Steel

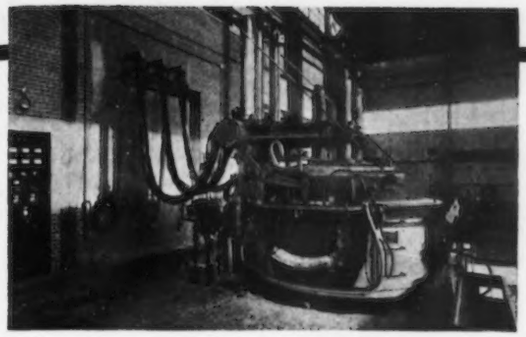
Ultimate Strength, Lb. Per Sq. In.	Yield Point, Lb. Per Sq. In.	Elongation in 2 In., Per Cent	Reduction of Area, Per Cent	Brinell Hardness
Bar 0.505 in. in diameter, direct quench				
166,000	145,000	15	50	369
Bar 0.505 in. in diameter, pot cooled and reheated				
130,000	105,000	23	57	285
Bar 1 in. in diameter, direct quench				
136,000	105,000	18	47	269
Bar 1 in. in diameter, pot cooled and reheated				
121,000	98,000	23	49	241
Bar 2 in. in diameter, direct quench				
113,000	85,000	26	58	269
Bar 2 in. in diameter, pot cooled and reheated				
108,000	81,000	24	55	228

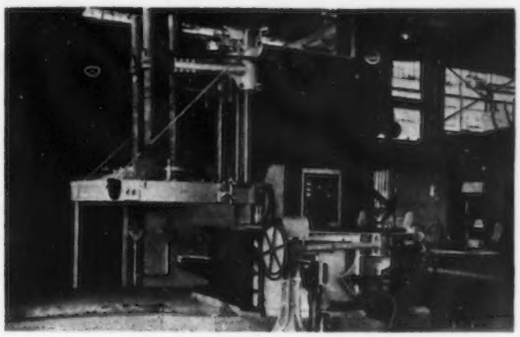
Susceptibility to Heat Treatment

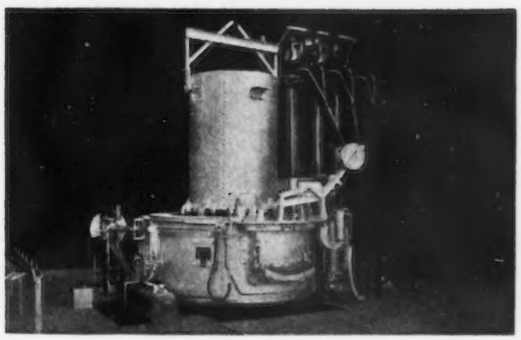
The susceptibility of tool and structural steels to the effect of heat was examined during the year on the Continent by F. Rapatz and W. Wrazej.

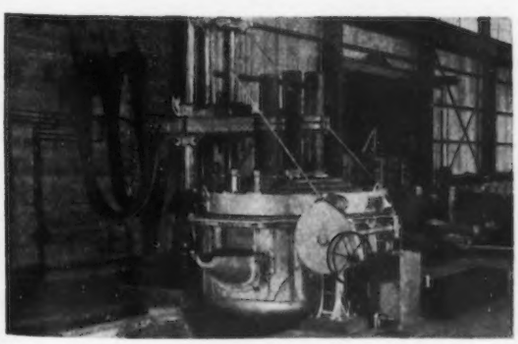
Their experiments showed that two tool steels, with about 1.1 per cent of carbon, though of almost identical chemical composition, behaved quite differently, which was attributed to the mode of deoxidation. One steel was deoxidized with aluminum, the other without this addition. The former did not harden (the hardened layer was only 0.078 to 0.195 in. thick), even at a temperature of 1600 deg. F., whereas the latter steel hardened almost completely throughout. In the fracture of the first steel, the hardened layer had a velvety appearance, whereas the fracture of the second revealed coarse grains. On heating to 2190 deg. F. the aluminum-killed steel was less overheated than the other. Hot extraction of the dissolved gases showed that there was less oxygen in the aluminum-killed steel and less hydrogen and nitrogen in the other. A manganese steel (0.9 carbon, 1.8 manganese), containing 0.2 per cent of vanadium, behaved like the aluminum-killed steel. Such a difference in the behaviors was ascribed not only to the oxygen dissolved by FeO, but also to that dissolved by MnO, which is possible at higher temperatures. On the other hand, the forms SiO_2 or Al_2O_3, etc., with which oxygen is combined, hinder the solution of oxygen. The soluble oxygen causes the steel to tend to harden throughout, and also to form coarse martensite. The addition of a strongly deoxidizing element, no matter which, has the reverse effect. In insufficiently deoxidized steels, the martensitic hardened layer is disseminated with small flakes of troostite; these are often linked together by small cracks, which cause the tool to break up in use.

The investigators' observations on the varied behavior of medium-hard (0.35 carbon) steels dealt mostly with machining results on over 1000 press-forged and heat-treated casts from 25-ton heats. Some hardened deeply with adequate surface hardness, others









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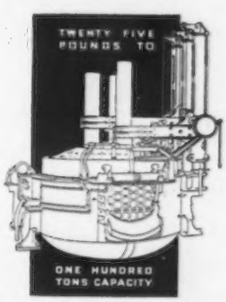

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hardened only superficially with local soft spots. For this reason prior hardening tests were made, heating the pieces to 1400 to 1560 deg. F. and quenching in cold water. From the fractures of the specimens and measurements of the surface hardness the susceptibility of the steel to heat treatment was judged. In this way, hardening cracks and fractures were avoided. Generally speaking finished pieces were heated to 54 to 90 deg. F. above the Ac_3 and quenched in water only after they had air-cooled to the Ar_1 point. As the furnace man does not alter his operating method, once established, the steels nevertheless behaved differently. This variation in the property of the steel produced not only is ascribed to the character of the deoxidation, but also to the course of the entire refining process, details of which are often not watched closely. The tendency of certain structural steels killed with aluminum to harden only on the surface must be considered disadvantageous. The thin hardened layer, martensitic after quenching and transforming into troostite on tempering, can be removed during further machining.

Two carbon steels (0.35 carbon) of very similar analysis were made in a 700 lb. high-frequency furnace from the same charge; they were deoxidized, rolled and heat treated in the same way. Yet the tensile strength, yield point and elastic limit of one steel were higher and the elongation and notch impact value lower than the corresponding values of the other steel. The investigators connect this difference of behavior of the two steels, similarly made and treated, with the temperature of the melting process and the possibility of the solution of gases, which have an outstanding influence on the quality of the steel. If the dissolved oxygen, as is assumed, is to be regarded as the cause of the varying behavior of steel, and the degree of deoxidation plays a determining part, yet there is no practical possibility, unfortunately, of determining, during the working of the heat or before tapping, the quantity of strongly deoxidizing addition required.

Normally produced structural steel, with its tendency to form a thick hardener layer, is a valuable material of construction. Such steels are much more widely used than the non-hardening steels. On heating to higher temperatures — for instance, forging temperatures (2100 to 2190 deg. F.)— normal hardenable steels develop a grain size no worse than that in non-hardening steels. The forging refines their grain again, and subsequent heat treatment develops excellent properties. As the critical temperature of grain-growth (1850 deg. F.) of the non-hardening, so-called fine-grained steels lies 180 to 270 F. deg. below the normal forging temperature 2100 to 2190 deg. F., the behaviors of the hardening and non-hardening steels at higher temperatures have practically no significance. The aluminum deoxidation products form marks and streaks on finely polished surfaces. For the determination of the ability of steels to carburize, the McQuaid-Ehn test is useful, according to the investigation, although it does not give exactly determined values for practical use, because these are dependent on the degree of forging of the steel. For the classification of medium-hard and hard structural steels the hardening test at temperatures of $Ac_3 + 36$ F. deg., $Ac_3 + 108$ deg. and $Ac_3 + 180$ deg., combined with an examination of the fracture (depth of hardness) and of the surface hardness, can be used. In exceptional cases, the test can be amplified by a determination of the hardness of the cross-section or by microscopic investigation.

Treatment of Cast Iron

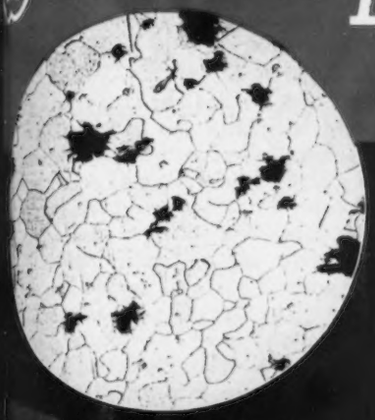
An excellent investigation of the heat treatment of a number of cast irons of various compositions (specimens 1.17 in. in diameter) was completed during the year by E. Piwowarsky and E. Sohnchen. It was found that by oil quenching and tempering the strength could be raised to 85,000 lb. per sq. in. Also verified was the fact that irons with the lowest contents of carbon plus silicon responded best. The composition ranges in which chill castings possessed better properties than sand castings were determined. Moderate additions of nickel, chromium and molybdenum improved the mechanical properties greatly, especially in the cast and annealed conditions. Regarding the heat-treated state, the dimensions of the specimens chosen were too small to reveal the beneficial effects of the special elements for high rates of quenching or cooling. The wear resistance of gray cast iron can be raised considerably by quenching, and the lower the carbon plus silicon content, the better is the retention of hardness on tempering. Having regard to this fact, and with moderate additions of alloy elements, the maximum strength properties attainable by quenching and tempering always coincide with a high resistance to wear, according to the experimental data. This does not apply to the same extent to the corrosion resistance, which is generally reduced by tempering the quenched gray iron.

An investigation by R. Hanel during the year dealt with the influence of the structure on resistance to wear, viz., quantity and distribution of the graphite, and the properties of the ground mass and, also, the theory of the martensitic structure in the production of martensitic cast iron, as being the hardest grade, together with practical methods of inducing a martensitic structure.

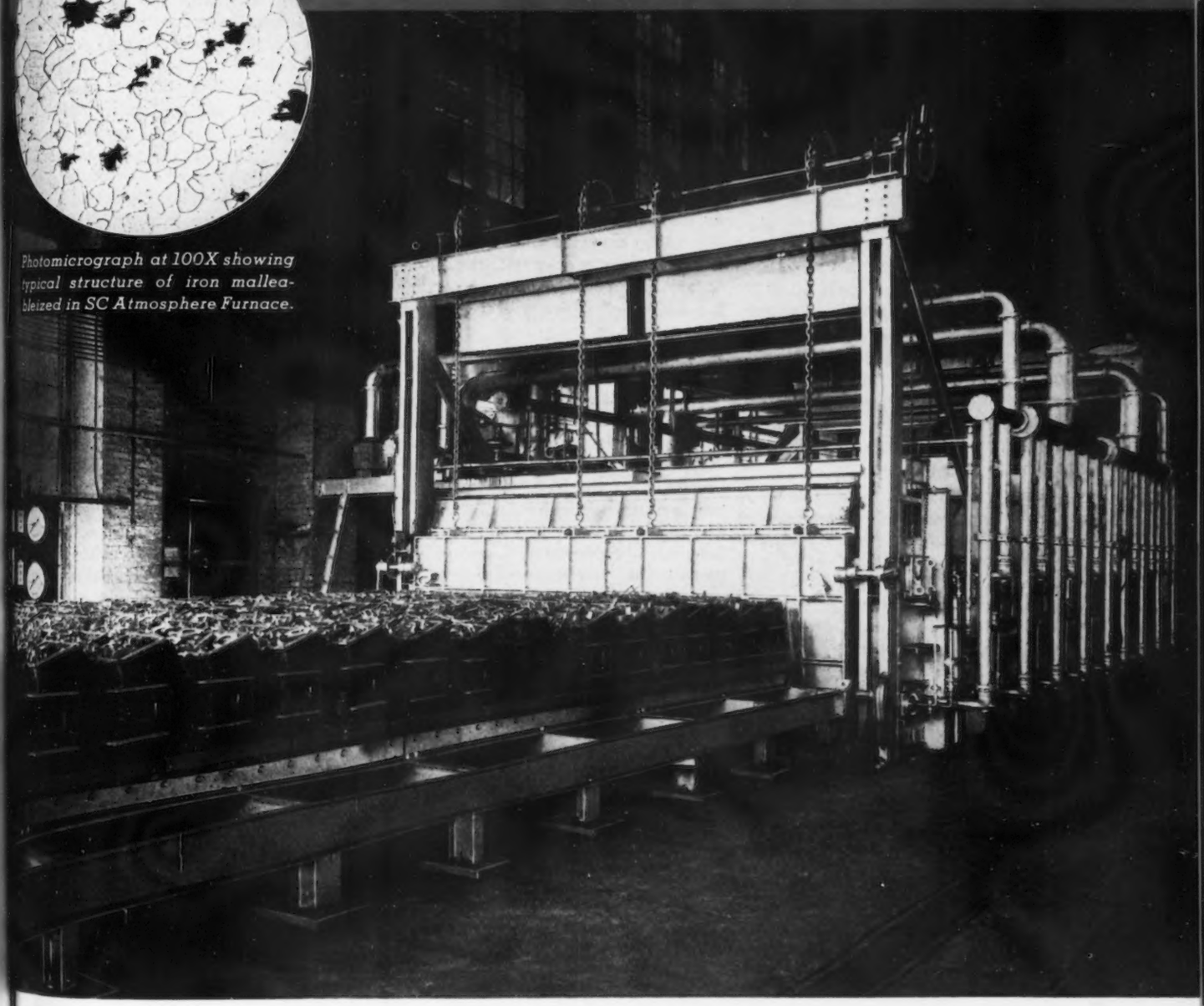
To produce martensite, it was shown that care must be taken to see that the transformation takes place at 390 to 480 deg. F. instead of at about 1290 deg. F. This lowering of the transformation point can be attained by (1) accelerating the cooling beyond the critical limit, and (2) alloying the iron with elements (e.g., manganese or nickel) which lower the temperature of transformation even at slower speeds of cooling. Manganese is practically excluded, since, due to its strong carbide-forming tendency, it prevents the development of the graphite and makes gray cast iron white and unmachineable even with higher percentages. By suitably combining these methods, there are several possibilities for heat treating gray cast iron for the production of martensite. Mr. Hanel has constructed diagrams which show (1) the lowering of the transformation temperature by rapid cooling only, (2) partly by alloying and partly by cooling, (3) by alloying only, (4) by alloying up to the formation of austenite, with subsequent heat treatment. The investigation was concluded by a discussion of the heat treatment of austenitic iron.

Two Polish researchers, S. Pilarski and L. Szenderowski, early in the year ran off a number of experiments to evolve a simplified heat treatment for gray iron. A method of heat treating cast iron was sought that would produce such cooling velocities that metallographic structures could be obtained equivalent to the best that can be produced. The results showed that cast iron in general is susceptible to heat treatment and that ferritic-pearlitic cast iron can be converted into pure pearlite, even though the total carbon and silicon amounts to 5.6 per cent. The emulsion used as a quenching agent consisted of 0.5 per cent linseed oil in water saponified by ammonia; the salt baths used up to 930 deg. F. were $NaNO_3$ and KNO_3 in equal parts, and for higher temperatures 30

CONTROLLED ATMOSPHERE MALLEABLEIZING



Photomicrograph at 100X showing typical structure of iron malleableized in SC Atmosphere Furnace.



Marked reductions in the annealing cycle have been made in malleableizing furnaces equipped with SC gas-fired *radiant tube* heating elements and provided with a controlled atmosphere. Where previously but 25% of the total load heated was castings, in these new continuous and batch-type controlled atmosphere furnaces 75% of the total load is net. In protecting against scaling and excessive decarburization by use of controlled atmosphere, it was possible to eliminate the tare weight of pots and boxes, compound, and cars—thus saving fuel and time as well as considerable labor. The malleableized iron produced in this type of furnace is a fully annealed standard commercial iron essentially free of pearlite. See photomicrograph at 100 magnifications. During graphitizing and cooling periods particularly the gas-fired SC *radiant tube* heating elements are very efficient in permitting exact control of furnace conditions. Controlled atmosphere malleableizing is the right answer to lower costs and higher production. Ask a Surface Combustion engineer in to talk it over with you if you make or use malleable iron. Without obligation, write for information, to

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KCl, 30 NaCl, 20 K_2SO_4 and 20 per cent Na_2SO_4 was used. Phosphorus, Cr-Ni, and Ni-Cr-Mo cast irons were investigated and the test results for each type determined.

Still another interesting investigation on gray cast iron was carried out in the U.S.S.R. by S. Pilarski and L. Szenderowski, and dealt with the optimum heat treatment to develop maximum breaking loads. The usual treatment applied to cast iron in order to increase its mechanical properties, consisting of quenching and tempering, was considered too drastic and was said to lead to defects. On the basis of work by Davenport and Bain, the investigators experimented with a method consisting of a mild quenching only; compressed air, a stable emulsion and a salt bath were used, and the tests were made on a high-phosphorus iron, a low chromium-nickel iron, and three irons containing various proportions of molybdenum. The results obtained were interesting, for in all cases they were superior to those given by the ordinary method of quenching and tempering.

In regard to the heat treatment of gray iron, a considerable difference of opinion exists among investigators concerning the interaction between the graphite and metallic matrix of cast iron at temperatures above the Ac_2 point. To ascertain the real behavior of gray iron at such temperatures was the subject of an investigation during the year by G. I. Pogodin-Alekseyev. Samples of iron were heated in a platinum resistance furnace for 20 min. at temperatures of 1380, 1470, 1650 and 1830 deg. F., and in one series of experiments were quenched in oil while in another series they were allowed to cool slowly in a material of low heat conductivity or in the furnace. All the quenched samples were reheated for 30 min. at 1005 to 1022 deg. F., and the combined carbon was then determined by chemical analysis. The results confirmed the view according to which heating of gray iron results in the solution of graphite in austenite and an increase in the combined carbon, this increase becoming greater as the temperature of the heat treatment is raised. As was to be expected, the opposite was observed in the case of the slowly cooled specimens. Another phenomenon associated with the heat treatment of cast iron is its growth, which occurs not only during the heat treatment but also during subsequent service, for instance in the form of pistons of internal-combustion engines. The growth is also accompanied by a deterioration in the structure and properties of the iron. It was shown that primary growth of cast iron is due to the increase in volume accompanying the decomposition of cementite into a mixture of ferrite and graphite, and secondary growth is due to high temperature corrosion or oxidation. Various factors which promote or inhibit secondary growth were determined.

In conclusion, it might be of interest to quickly review one of the year's experiments dealing with the case hardening of gray iron with beryllium, namely the work of Joseph Laissus. The iron used for the experiments (T.C. 3.53, Cr 3.08, Si 2.47, Mn 0.66, S 0.033 and P 0.354 per cent) was in the form of small cubes of 0.27 in. on each side and carefully polished. These were placed in the center of a cement made either of 98 per cent pure Be or Fe-Be containing 80 per cent Be. These were highly pulverized and mixed with 25 per cent by volume of glucine. The duration of cementation was 2½, 5 and 10 hr. at a temperature of 1470, 1650, 1830, 2010 and 2100 deg. F. The diffusion of Be into gray iron and the properties of gray iron cemented by Be were thus determined. Cementation of gray iron by Be is of the same order as that of iron and ordinary carbon steels cemented by the same element; with this difference, however, that the layers obtained are of much greater magnitude in the case of iron. Surface hardness of gray iron cemented by Be is remarkable. The maximum figure obtained, 1561 Vickers' hardness, exceeds those which had been considered the highest attainable with metals. For instance, nitrided steels reached a figure of 1100 to 1200. The formation of rust by the action of either ordinary or salt water is retarded after the iron is cemented by Be, but this treatment was found to be practically useless against the action of chemical reagents attacking non-cemented gray iron.

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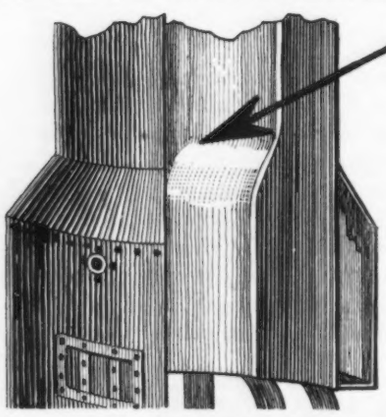

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WELDING AND FABRICATING

Increased mechanization of welding a feature of 1937 development. Applications expand in structural construction, ship building, on railroads, dam construction, etc.

BY W. SPRARAGEN

Technical Secretary,
American Welding Society

THE end of the year 1937 finds welding solidly entrenched as one of the world's leading production and construction methods. Almost everywhere the frontiers of application of welding have been pushed forward slowly and surely.

Welding Wire Output Growing

During 1936 more than 140,000,000 lb. of steel welding wire was produced, or enough to make a strong weld 134,000 miles long, it is estimated by the American Iron and Steel Institute.

The total production of steel welding wire in 1936 represented an increase of about 480 per cent over the 1932 output of 24,150,000 lb., which compares with an increase of about 250 per cent in steel ingot production over the same period. In consequence, the amount of welding wire produced per ton of ingots increased steadily from 1.79 lb. per ton in 1932 to 2.16 lb. in 1933, 2.78 lb. in 1934, 2.89 lb. in 1935, and 2.95 lb. in 1936. Statistics for the year 1937 indicate that the trend in the use of welding wire is still steeply upward.

Codes

Probably the most conservative engineers in the world are the civil engineers—and they have to be. Their buildings, bridges and dams, once erected, are built to stay until obsolescence makes their destruction, removal or replacement desirable.

Nineteen thirty-seven saw the two largest cities in the United States making provisions for welding in their building codes. I refer to the new codes adopted by New York and Chicago. As these large cities cannot afford to "pioneer," it is not surprising that these last barriers were removed only after some 200 other cities and municipalities have seen the advantages of welding in noise elimination, better earthquake and wind bracing, greater facilities in repair of existing buildings and last, but not least, important economies.

It is interesting to point out that Chicago has paved the way in taking advantage of the higher unit stresses allowed by the new proposed building code of the American Welding Society when heavy covered electrodes or superior gas welding filler rods are used. I believe Chicago is first in this respect.

Welding Becomes Mechanized

If we were to point to any single startling development in 1937, it would be to the increased mechanization in the use of welding. The author has seen new hydromatic welders in operation where complicated parts of automobile frames or bodies are placed in a machine, a button pressed, and then a sequence of welding operations starts almost faster than the eye can

(Photo by courtesy Bethlehem Steel Co.)

o o o

ALL-WELDED steel elliptical ladle which, without brick lining, weighs 31,260 lb. net, and has a metal capacity of 120 tons. It replaced a riveted plate and cast steel ladle weighing 54,000 lb. net, and having a capacity of 100 tons. After welding the entire structure was carefully stress relieved.

o o o

follow in which spot weld after spot weld is made in just the right place and with just the proper current and pressure to assure its soundness without the touch of human hands.

Nor is this mechanization confined to spot welding alone. Parts of a refrigerating unit held together by one or two "spots" are placed in the machine where little knobs or protrusions hold them accurately in position, the operator presses a pedal, four wheels descend, and four gas-tight welds are made at a rate of several feet a minute. The platform of the machine moves steadily forward to the end, the wheels are automatically lifted, move over an inch or two, the platform moves in the opposite direction and the four wheels proceed at their specified rate in the opposite direction making four new seams under water and in a minute or so the complete unit is made gas-tight. All this has been made possible by developments in electronic timing devices, which minutely meter out the amount of current and its duration in forming a series of literally thousands of overlapping spot welds, each one accurately and uniformly the same as the other.

Of course we say that resistance welding in its various forms is always considered a production tool, but how about the other processes of welding? They too have become mechanized.

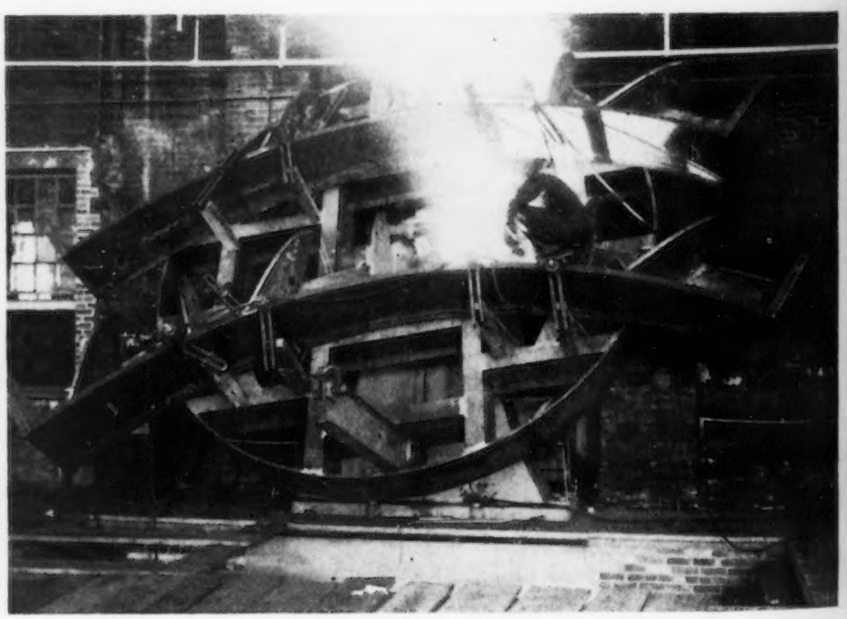
Automatic arc welding, using a.c. and d.c. current, bare or covered electrodes, are standardized methods of production in pressure vessels, machinery and almost everywhere where repetitive work is called for. It would take a volume to describe in detail each of the new developments which have made all this possible, but in the short space of a few years these welds have increased in strength from 50,000 lb. per sq. in. to 60,000 and even 100,000 lb., where needed. Impact values, as measured by the Charpy standard tests, have jumped from 5 to 50 ft.-lb. The endurance limit, where this is important, has been raised to that of the steel itself.

Gas welding and cutting has kept pace. I have seen automatic gas welding operations in the welding of tubes, tanks, containers and almost every place where light gages of steel are used, welded accurately and solidly in a manner that could not be duplicated by any other method.

Gas cutting continues to be the marvel of the age. Four, five and six cuts are made, following a master pattern so accurately that further machine work is unnecessary. In fact, many of the machine operations, such as beveling, gouging and rough machining are now being done by the mechanized gas torch. Some of the newer developments will be described later in this review.

The Steel Maker Helps

Ever-increasing temperatures accompanied by higher pressures (or sometimes very low temperatures) are needed for the most efficient operation of some chemical and process industries. These efficiencies were pipe dreams in the minds of laboratory men until welding made it possible to economically fabricate vessels 3, 4, 5 and even 6 in. thick. But there is an upper limit, not due to welding, but to the bending and forming operations. The introduction of some carbon molybdenum steels in certain oil refinery operations has enabled the reduction of the required thickness of the steel to 40 per cent of plain carbon steels, owing to the superior properties



(Photo by courtesy American Murex Corp.)

THE huge hydraulic turbines built by the S. Morgan Smith Co. for the Bonneville Dam project, the largest of their type ever built in the United States, are of welded steel. The welding of a part of one of the units is pictured above.

OPERATORS PICK BEST WELDER

STRAIGHT from welding operators comes overwhelming proof that the New Westinghouse FlexArc is today's best welding buy. In a nation-wide poll among hundreds of operators we asked them to tell us frankly: "How does the FlexArc *compare* for speed, ease of operation, quality welds? Do you like its safety features?"

By an overwhelming vote these men put their OK on the New FlexArc. "It welds FASTER" said 89%; "EASIER" said 90%; "BETTER" said 91%; "We like its SAFETY features" said 96%. A few remarks typical of hundreds of others are reproduced here.

Westinghouse invites you to let *your* operators try this revolutionary new welder. Ask them to put the FlexArc to the test in *your* shop, on *your* work. Like your operators, you will add a hearty OK for improved quality and lower welding costs.

Your Westinghouse FlexArc Distributor will gladly put a machine at your disposal, without obligation to buy. Call him today, or mail the coupon for complete information. J 20197

CAN DEPEND ON IT—"When the FlexArc Pre-Set current control is adjusted it can be depended upon."—Geo. Gramme, Stephens-Adamson Co., Aurora, Illinois.

GOOD FOR OVERHEAD—"The FlexArc is the best for overhead welding I ever run across."—Siegfried Runge, Job Shop Welder, Boston, Mass.

SAFETY—"The safety of the New FlexArc, with its low open-circuit voltage, means just another worry taken away from the operator."—A. J. Mathy, Builders Steel Co., North Kansas City, Mo.

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THIS GUARANTEED WELDER
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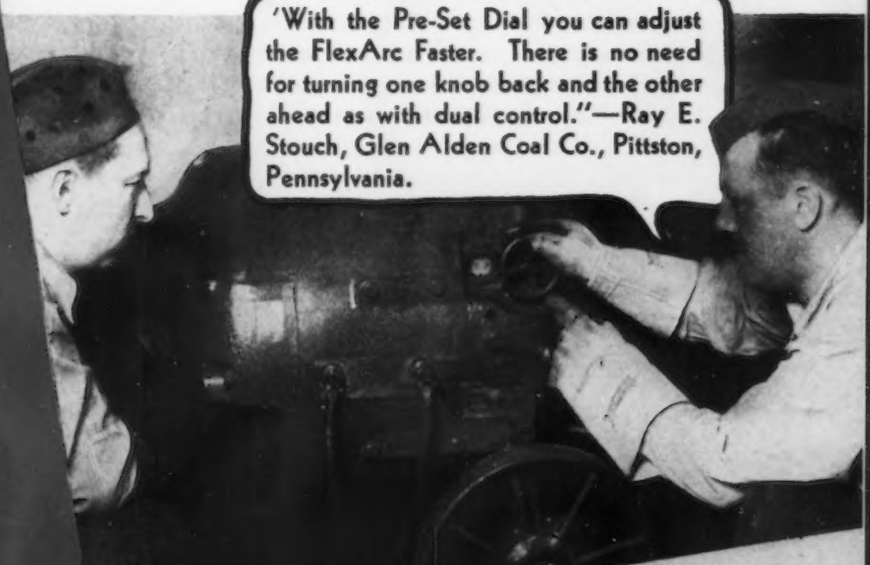

"With the Pre-Set Dial you can adjust the FlexArc Faster. There is no need for turning one knob back and the other ahead as with dual control."—Ray E. Stouch, Glen Alden Coal Co., Pittston, Pennsylvania.

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Flexarc Welder

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of these steels at the temperatures needed, but the welding wire manufacturer has also kept pace. In these same steels he has been able to produce welds with physical properties equal to the parent metal, thus allowing advantage to be taken of the superior qualities of these steels.

Jigs, Fixtures and Manipulators

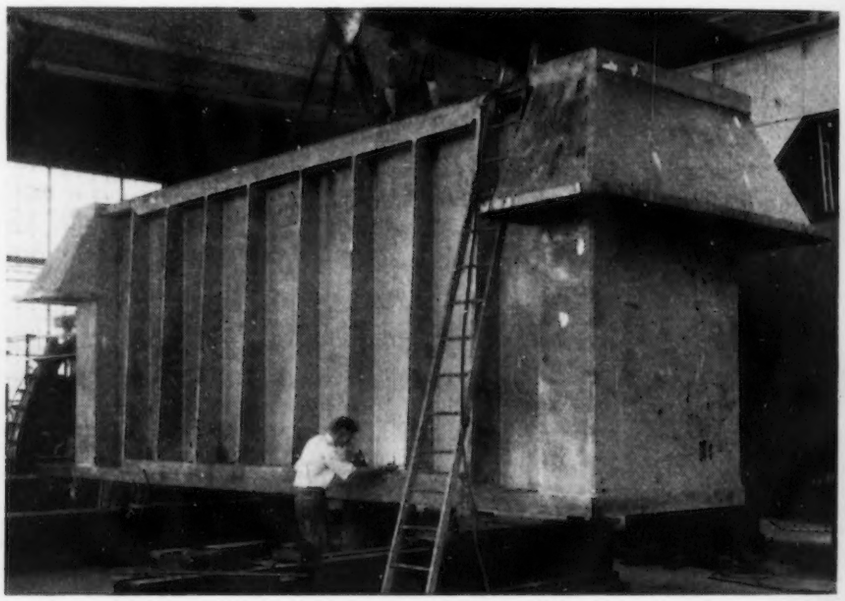
It was not so long ago when a welding operator had to make his weld in almost any position, even though it was well known that the downward or flat position welding gave superior quality of work at greater speeds. All this has changed. Manipulators are available for turning pieces of apparatus weighing several tons so that the welder can operate in the most favorable position. Jigs and fixtures facilitate production schedules and the maintenance of tolerances within close limits.

Shapes Suitable for Welding

Despite all the progress made in welding, the most economical shapes for general welding, and, in machinery construction in particular, are not yet rolled. The reason is that the welding engineer does not know the best shape which he requires for the various classes of work. There needs to be greater unanimity of opinion and some degree of standardization in these matters before a steel mill can be expected to install expensive new rolling equipment to produce these particular shapes. But the time is not far distant when these shapes will be produced.

In this important respect our European neighbors are likely to lead the way. Already their experimentation has indicated to them quite clearly that the butt weld even for tee joints possesses superior resistance to pulsating stresses or impact blows. Shapes having a nose or projection facilitating the making of a butt weld are already available in Europe. In the United States, the gas torch has enabled the fabricator to cut standard rolled sections in exactly the shapes needed. Bending equipment has enabled him to produce other sections from rolled flat plate economically for the purpose in hand.

Cooperation is being developed between the welding engineer and the purchasing agent. This enables the purchasing agent to supply the welding engineer with the parts needed in the fabrication of a particular machine or apparatus in the most economical way.

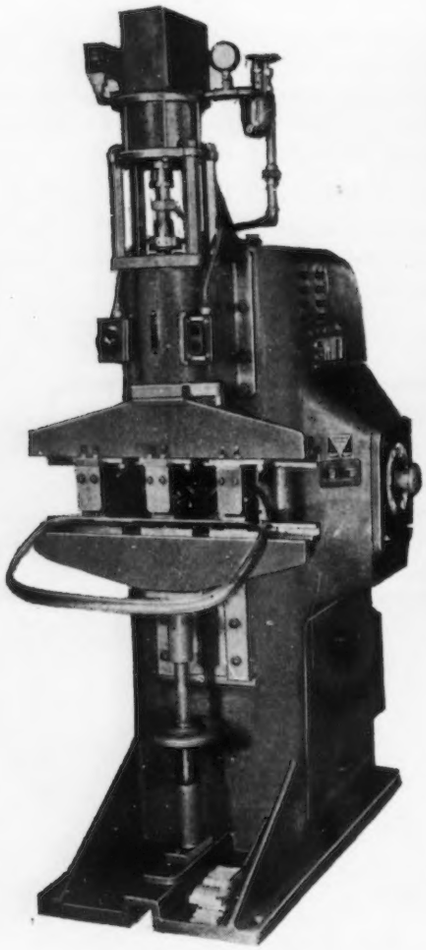


INSPECTING the all-welded bed of a 2000-ton press built by the A. O. Smith Corp. The bed alone weighs 170,000 lb.

The Influence of Welding on the Steel Maker

This is an era of light weight, high strength, low and high alloy steels. These steels possess unusual corrosion resistance and physical properties, some at high temperatures, some at low temperatures, and some withstand corrosive actions at either high or low temperatures. Others are known for their impact resistance, for their fatigue properties, for their stiffness and literally dozens of other qualities.

At first, the steel maker produced these alloy steels without particular regard as to their weldability. His argument was that if they could not be welded they might be riveted, but



3 projection welds per stroke of machine

•

SWIFT ELECTRIC WELDER CO.,

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Welding machines hand, hydraulic, cam or air operated of the following types: spot, seam, projection, flash, butt, flue and pipe, also gun welding units.

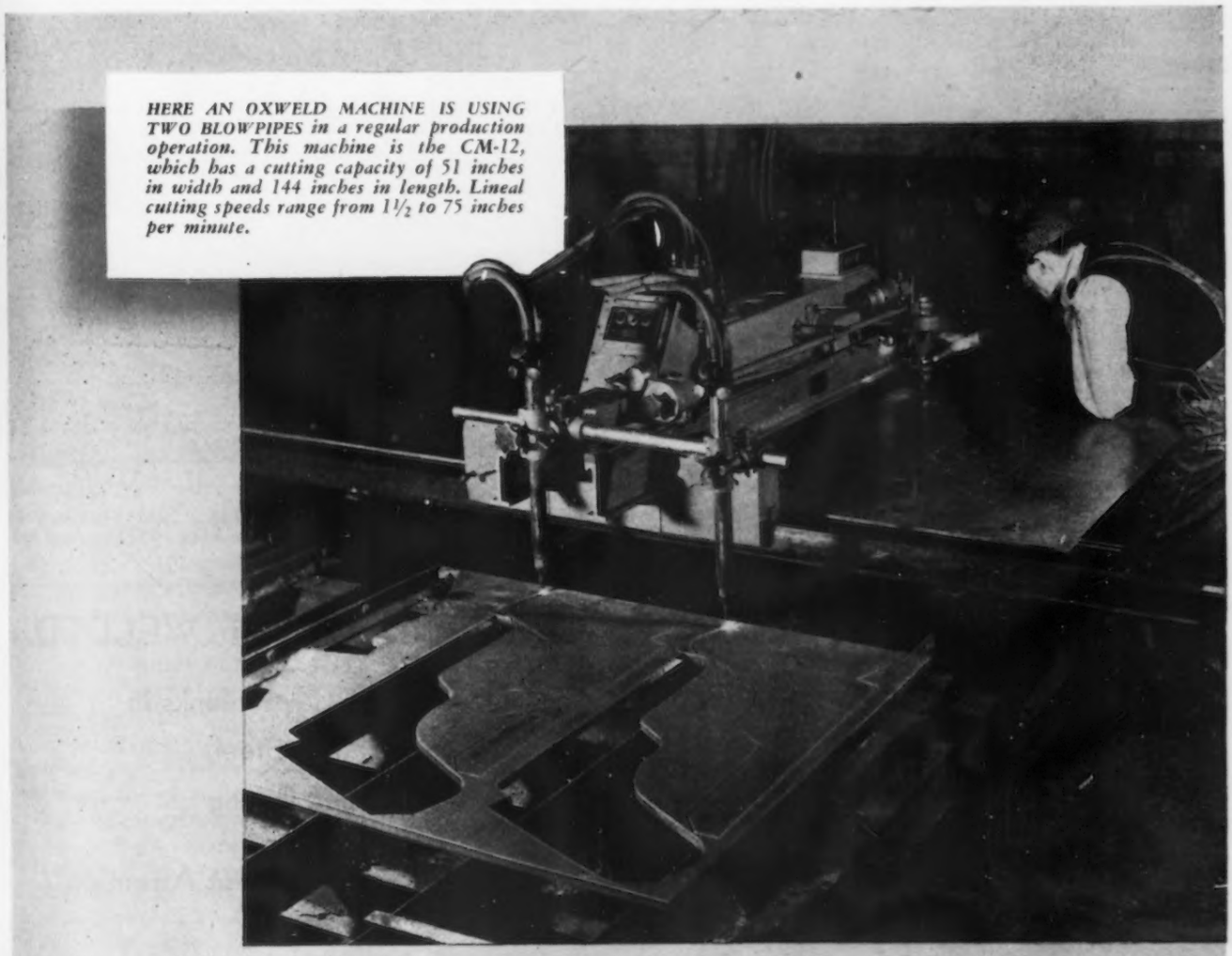
OXWELD SHAPE-CUTTING MACHINES

. . . *production tools for shaping steel*

STEEL shapes of any kind—simple flat pieces or complex shapes which require cutting in a number of planes—can be cut quickly and economically from plate or other rolled, cast or forged steel sections with Oxweld oxy-acetylene cutting machines.

There is an Oxweld flame cutting machine—portable or stationary, partly or fully automatic, of almost any capacity—for every cutting need. A representative from the nearest Linde office will gladly review with you the possibilities of improving cutting accuracy and of expanding and speeding up production in your plant with an Oxweld flame cutting machine. Your request for this help will not obligate you. The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, New York and principal cities.

The word "Oxweld" used herein is a registered trade-mark.



HERE AN OXWELD MACHINE IS USING TWO BLOWPIPES in a regular production operation. This machine is the CM-12, which has a cutting capacity of 51 inches in width and 144 inches in length. Lineal cutting speeds range from 1½ to 75 inches per minute.

Everything for Oxy-Acetylene Welding and Cutting

LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES FROM UCC LINDE UNION CARBIDE

tions of the machine which must resist wear flame hardened.

Oxy-Acetylene Cutting

Accuracy, ease, economy and quality in the oxy-acetylene cutting process have created new industries for the fabrication of heavy plates of rolled steel for all types of apparatus, machinery and equipment, replacing, in a measure, cast steel parts. The newer developments relate to more careful studies of the effect of cutting steel, the perfection of preheating and postheating for higher carbon steels, the control of warping, the development of flame machining and the cutting of some of the newer types of non-oxidizable steels.

At the recent annual convention of the International Acetylene Association developments in oxy-acetylene cutting, particularly those intended to overcome effects of cutting on the physical properties of certain "hard steels," were described.

On this the Oxy-Acetylene Committee of the association reported that: "Silicon structural steels have been more difficult to cut than mild steels without loss of impact resistance and in ductility of the cut edge. Such steels have sometimes required machining of the cut edge to depths of ¼ to ½ in.

"Use of multi-flame heating tips either before or after the cutting jet to reduce the self-quenching action of the cold base material and to retard speed of the air quench has made it possible to cut these steels without much impairment of the physicals of the cut surface."

In a paper at the same convention, H. H. Moss, Linde Air Products Co., told of the development of methods and equipment for this purpose. The method covers a variety of steels from medium carbon to low-alloy, high-tensile. It is referred to as "flame softening," and three types of the flame softening are employed.

Grades of steel softened to date are classified into: (1) quench hardening steels (plain carbon steels of medium carbon content, structural steels of low carbon and low manganese content, and some of the newer corrosion resisting low alloy steels) and (2) air hardening steels (those which harden when slowly cooled in shop atmosphere from temperatures above the critical point, such as the low-alloy high-strength structural steels).

Commercial apparatus has been developed to perform these treatments. The several units are for the most part assembled from standard equipment. Flame softening heat is provided by either seven flame or 30 flame water-cooled heads which are connected by straight and angular fittings to blowpipes providing adequate volumes of mixed gases.

Some of the applications for flame softening are suspension bridge towers, shaping and cutting of web and gusset plates for bridges, manholes, and in buildings where high tensile gusset plates for new and alteration work are required. Particular applications would also be in the construction of railroad vehicles and industrial equipment where low-alloy high-strength steels are used.

o o o

DEVELOPMENTS in oxy-acetylene welding, use of indirect or "submerged arc" welding, production obtained by resistance welding machines of recent design, and outstanding applications in shipbuilding, structural, railroad, tank and pressure vessel and other fields—and "what is in back of it all"—are interestingly "high spotted" in the remaining part of Mr. Spraragen's review, which will be included in a subsequent issue of THE IRON AGE.

CLECO

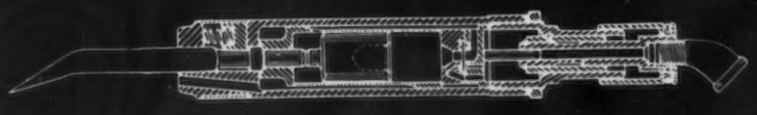
B1 SCALING TOOL

A Scaling Tool That's Different!

Different—and better—is this CLECO B1 Pneumatic Scaling Hammer. One outstanding special feature is the graduated control valve at the rear end of the tool—the harder you press, the more power you get! A special tool retainer holds the chisel securely yet releases it at a touch of the thumb. A square broached chuck keeps chisel from twisting. Exhaust blows away chips and scale.

CLECO B1 is ideal for general scaling, peining and beading; for undercutting when overlapping is necessary; for removing splatter after production welding.

Demonstrations arranged anywhere.
Let us mail you Bulletin 84.



THE CLEVELAND PNEUMATIC TOOL COMPANY

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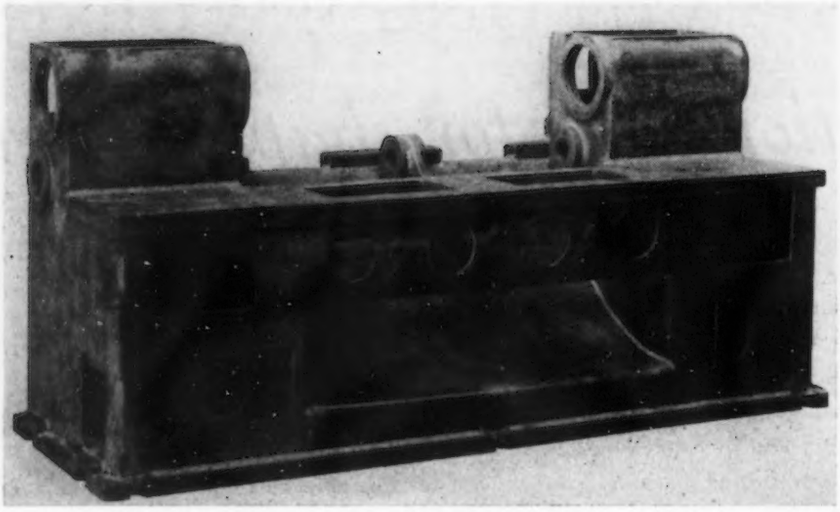
BRANCHES IN PRINCIPAL CITIES



(Photo by courtesy Lakeside Bridge & Steel Co.)

BED for a double-end lathe fabricated by flame cutting and welding. Coolant tanks are integral with the base, the walls of which are made from ¾ and 1-in. steel and top plate from 2-in. steel. The bed is 8 ft. long and weighs 6000 lb.

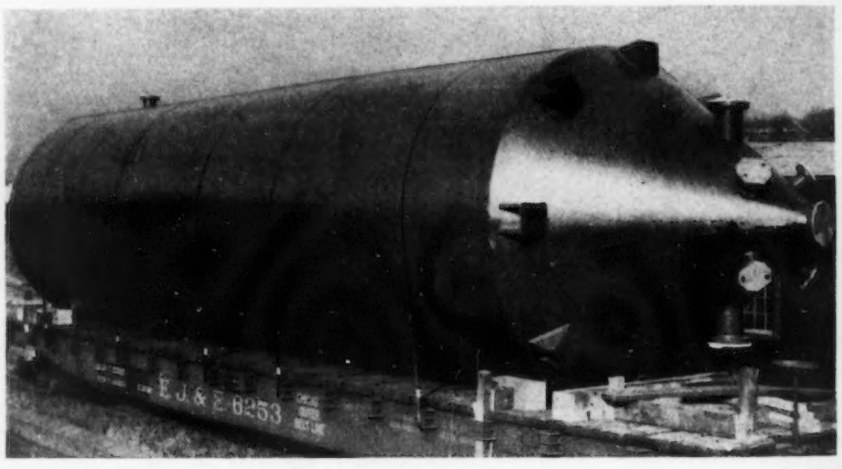
of him and, at the same time, offering him new opportunities for service.

Uniformity of product was the steel man's watchword and it still is from one viewpoint. However, he now produces steel rails with the ends already hardened to resist wear. He produces clad steels where the cladding gives the necessary corrosion resistance properties and the steel the necessary strength, both produced at a comparatively low cost. Through the aid of welding, these parts are now fabricated into solid units and the qualities of each portion of the cladding are the same as the respective portions of the base metal.

I have seen in one shop steel as it came from the mill, machine gas cut to the proper dimensions, arc-welded in special jigs with the newest types of electrodes, stress-relieved, and por-

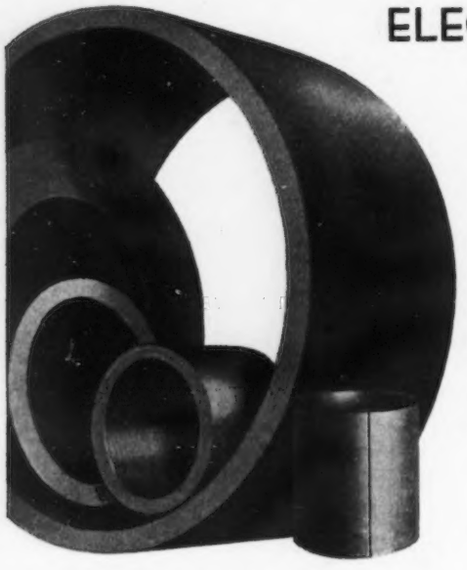
the rapid advances in welding have changed all this. Now the steel maker keeps definitely in mind that his product must be weldable and as nearly fool-proof as possible. In some instances, he produces these desired results by keeping the carbon low, sometimes below 0.20 per cent and other times below 0.14. In some instances, he must add stabilizers such as columbium or titanium.

Almost all of the descriptive literature issued by these steel makers not only gives physical properties, but also definite instructions and precautions in regard to the weldability features. Welding, without question, has its influence on the steel maker. As a matter of fact, it has been partially responsible in giving the steel maker new conceptions of what is expected



(Photo by courtesy Combustion Engineering Co., Inc.)

THIS weld-fabricated digester for pulp and paper mill is 11 ft. 3 in. in inside diameter and 49 ft. 6 in. long overall. The shell is 1 11/32 in. thick, the top head 1 7/32 in., and the cone 1⅝ in.



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Rings, Bands, Ring Gear Blanks In
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Your Inquiry Will Receive Prompt Attention

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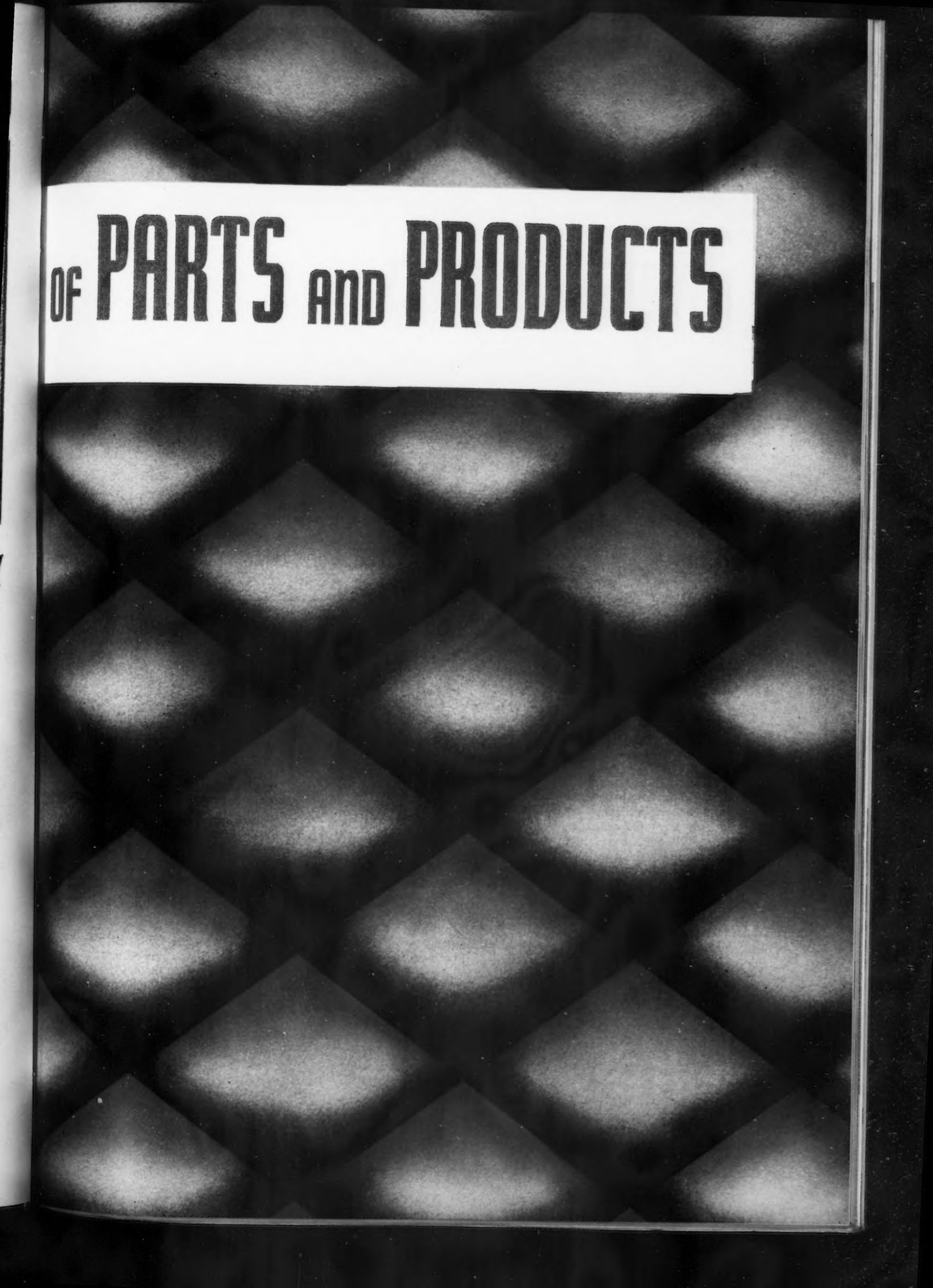
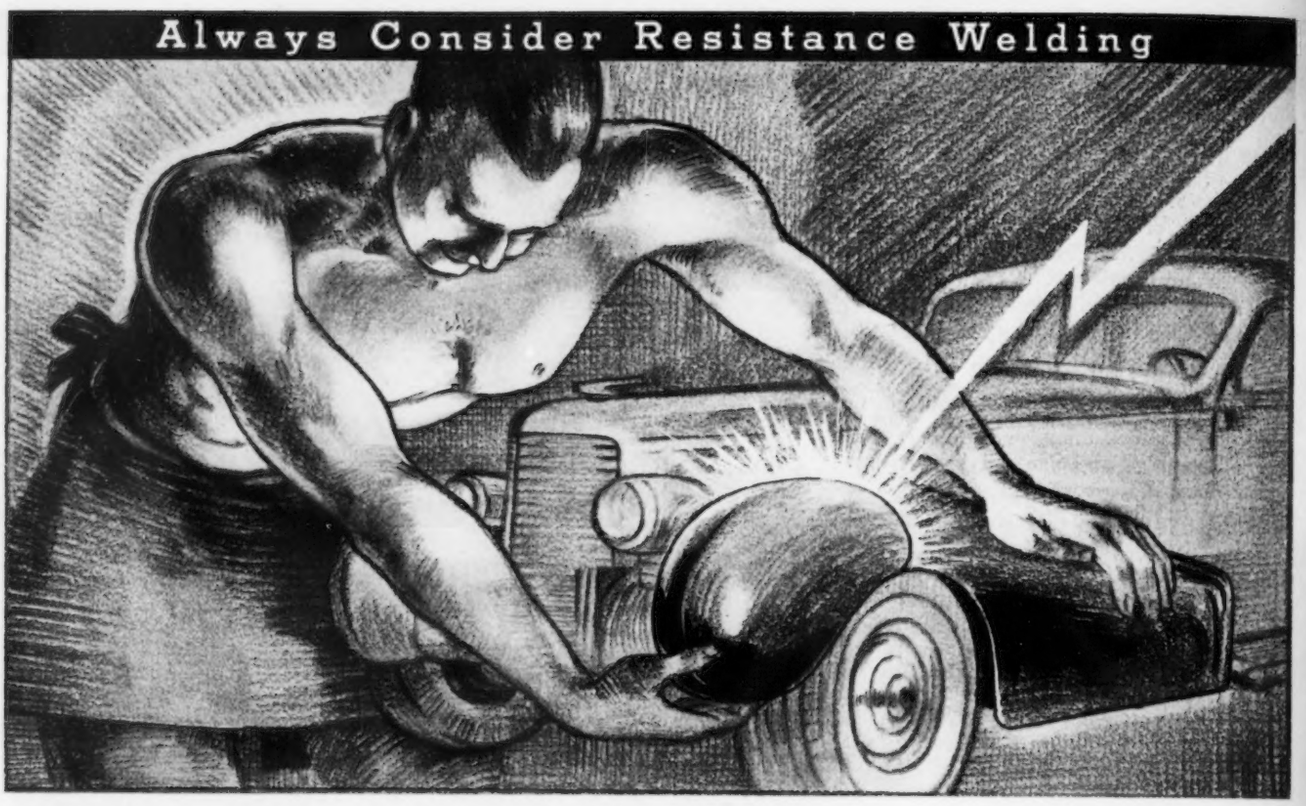
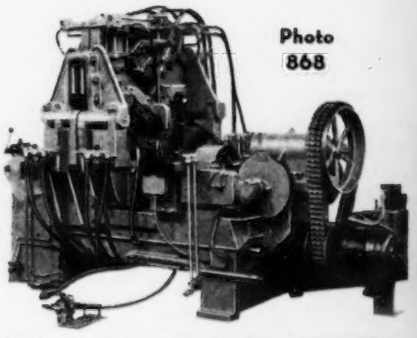

OF PARTS AND PRODUCTS



RESISTANCE WELDING • *An Economical Process for Improved Design*

● It is not enough that Resistance Welding has contributed to industry a modern method of metal fabrication to speed up production, lower costs and strengthen assembly. Resistance Welding has given something more —something that increases sales opportunities many times over—and that something is greater possibilities for improved design. With this modern tool of industry at their command, creative engineers have designed products, large and small, with structural beauty heretofore impossible and undreamed of.

Federal Engineers, with 26 years of welding experience, are constantly meeting and solving metal fabrication problems with standard and special machines that set new standards in production possibilities and efficiency. To their application and use may be attributed much of the attractiveness and consequently the saleability of modern motor cars, refrigerators, washers, desks, chairs, motorcycles, hardware, toys and innumerable other items. Resistance Welding is ready to help you in the fabrication of metal parts for improved beauty, greater strength and more efficient, economical production.



● The Federal Fender Welder shown, Photo 868, one of several built for a leading motor car manufacturer, is rated at 200 KVA and with suitable dies, welds front, rear, right and left hand automobile fenders. These welders have mechanical drive through worm gear reduction, Reeves Vari-Speed drive, giving 3 to 1 ratio of speed changes, and 2 H. P. motor. Two upset cams are used on a common shaft to insure accurate push-up and upset. The clamps are hydraulically operated from an oil pump and are articulated to insure accurate electrical contact and uniform pressure all along the sweeping curves of the weld line. About 45 welds per hour are made on each welder, with no scrap.

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MACHINE & WELDER CO.

SALES OFFICES IN - WARREN, OHIO ALL PRINCIPAL CITIES

Suppliers OF PARTS AND PRODUCTS

Lively pace during first part of year stimulated business of the parts suppliers. Improvements in design and quality kept pace with general advance of industry.

o o o

By R. H. LAURENCE

o o o

TO the problems of parts making are devoted many of the best brains in the fields of materials, invention, engineering and mechanical design, styling, production, market development and sales engineering. Untold numbers of the older manufactured products literally have been revolutionized through the untiring efforts of the parts makers. Numerous new products have come into being because of their activities. It is to the restless spirit of progress of the parts makers of America more than to any other single factor that in American industry today "nothing is permanent but change."

Check off against the Products Index in the back of THE IRON AGE those items which can be classified as "parts." Believe it or not, there are over 240 of them! If that is not convincing enough, check off the names of companies advertising parts. Taking at random the issue of Nov. 11, 1937, we find that there are more than 80 of them—including some of the most important companies in the United States.

The significance of all this is that a subtle but sweeping change has come over industry in America—at least that section of it devoted to the manufacture of things of a mechanical nature. This change consists in its cleavage into two distinct yet intimately related divisions. One of these divisions specializes in making parts, the other in putting those parts together. In some cases the two divisions may exist within one organization, as in the case of a few large automobile manufacturers.

The average reader of this review is quite familiar with the extent to which accurately and completely finished parts, unit assemblies and accessories enter into the building of modern motor cars. So common has this practice become that the one-time distinction between the so-called "assembled" car and the "manufactured" car seldom if ever is drawn. Practically all of them are now to a large degree "assembled" cars. Even though many of the parts and unit assemblies may be manufactured under the name of the parent company, it is very common to find these departments, divisions or subsidiaries with most of the characteristics of independent, self-contained manufacturing enterprises, manned and managed by specialists.

The Machine Tool as a Parts Market

It may be more effective if we emphasize the rising tide of parts manufacture in relation to something other than the automobile industry. Looking over the field of industrial machinery as covered by this Annual Review Number of THE IRON AGE, let us consider for example the machine tool industry.

There was a time—and it was not so many years ago—when this was very largely a self-contained industry.

In 1938 — Dodge Steel Castings

A GOOD time for taking stock of ourselves, and our products, is the beginning of each new year.

Machinery builders continue to increase the strength of essential parts, and many are also reducing weight and bulk, by replacing weaker materials with steel castings.

Designers are conversant with the far reaching costs, both to users and to their reputations, of breakdowns occurring during periods of heavy production; and knowing breaks are most likely when work is speeded, they are resolved *none shall occur*, even though machinery is hard driven and abused.

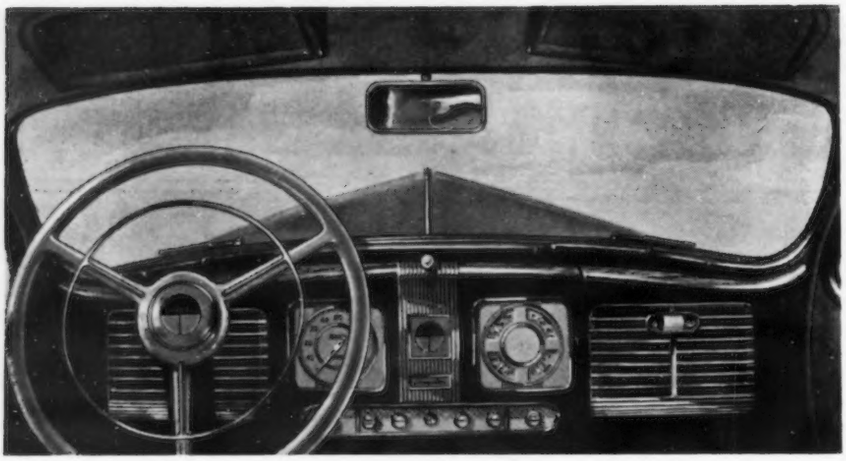
Greater strength, and space enough for additional assemblies without enlarging the machine itself, have more than once made possible important improvements, increased capacity, and greater utility.

The Dodge organization welcomes every opportunity to consider the problems of all who use castings, and who are concerned with improving their products.

To the readers of The Iron Age we sincerely wish: *worthwhile achievement* and *deserved prosperity* during the year 1938.

Dodge Steel Company

6501 TACONY STREET • PHILADELPHIA, PA.



THE die-casting business is a splendid example of part supplier initiative. Above is the die casting embellished instrument panel of a Chrysler.

The typical plant was made up of a general machine shop, a forge shop, a pattern shop, and a foundry equipped for making large and small gray iron castings and small brass and bronze castings. Into this plant came pig iron, materials for the special brass and bronze "mixes" favored by the management, and bar iron and steel. Out of it came finished machine tools of the relatively simple designs of the carbon tool steel era. These machines were almost 100 per cent made on the premises, even to the bolts, screws and nuts by which their parts were fastened together.

Now let us consider the manufacture of a modern machine tool—a turret lathe for instance. Gone are the foundry, the forge shop and the pattern shop. A highly specialized machine shop has taken the place of the old general machine shop, and a spacious and well-equipped assembly floor, closely associated with a large and highly systematized stock keeping department, has come into being.

Suppose we start at the bottom and work up through this turret lathe to see where the parts makers figure in the picture. First consider the chip pan. It is a light, rigid, neatly designed unit fabricated from steel plate and shapes by an outside welding concern which incidentally had a lot to do with developing its design. In other words, it is a *part* supplied by an outside source.

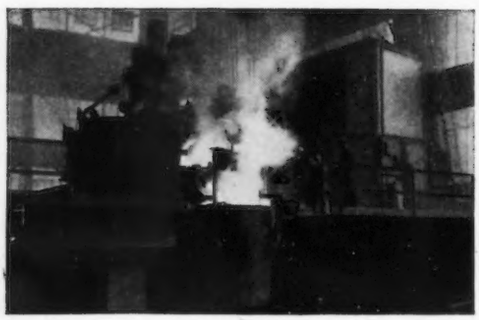
Next consider the bed and the headstock. These we find are castings of high-tensile iron—cast, sand blasted and partly finished in an outside foundry specializing in machine tool castings. They also are *parts* bought outside. Even the patterns to which they are made have been made by an independent pattern shop—outside *parts* again. Take a look at the spindle. It comes from an independent forge shop many miles away where it not only is roughed out under the hammers but also hollow bored and rough machined before delivery to the machine tool builder. Another outside *part*.

Checking rapidly over other details, we find precision anti-friction spindle bearings developed and manufactured by a well-known bearing manufacturer, the same being true of numerous other anti-friction bearings throughout the machine. Hardened and ground gears in headstock and feed works have been supplied by outside gear specialists. Clutches have been made by a company which concentrates on clutches. Lubricant is fed into bearings by an outside manufactured lubricating system and is kept from leaking out by patented rotary seals manufactured by still another outside organization.

Dozens of Other Terms

If space permitted, we could thus go on and on, mentioning push buttons, bronze bushings, nuts, bolts, springs and dozens of other things including the hardened drive screws by which are attached the outside purchased nameplate and speed and feed tables. All of them products of parts makers who in many cases had a lot to do with their development and with their eventual adoption by the builder of the machine.

That these and similar parts have a



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NATIONAL FORGE AND ORDNANCE CO.

IRVINE, WARREN COUNTY, PENNA., U. S. A.

great deal to do with this and hundreds of other mechanical products being better and more up-to-the-minute than they might otherwise be, is rather self-evident. Suppose, for instance, that precision ball and roller bearings were not in the nature of commodities —"parts for the trade," in other words —how many machinery manufacturers would be in a position to develop and manufacture their own?

Spring Making

The extent to which an energetic, experienced and well organized parts maker ties into today's industrial structure is shown by a partial analysis of the present markets of one of the large and long establishel manufacturers of springs. To mention only a few, this company's spring products are used in at least 30 automotive items ranging from air brakes to windows; in 15 important aviation details ranging from antenna reels to variable speed propellers; in 17 different electrical appliances; in eight miscellaneous machines and in nine important sections of textile machinery; in 19 varieties of office appliances; and in no less than 70 miscellaneous articles where the springs range all the way from the neck of a jack-in-the-box to the delicate precision springs embodied in clocks, cameras, scales and scientific instruments.

Materials Compete

It is not the purpose of this review to play any favorites. It is intended to tell a true—even though necessarily rather sketchy—story of recent technological advances, interpreted as to their significance to the parts industry. THE IRON AGE, in its 83 years of existence, has outlived what was primarily an age of iron; has lived through what might be called an age of the simpler steels; and lives vigorously on in the present era which to one group seems to be the age of alloy steels, to others the age of aluminum and the light alloys, and to still others the age of the plastics.

In other words, we are in an era when metals and alloys not only are competing fiercely with other metals and alloys, but when the same metals and alloys—fabricated in different ways—compete with themselves. Then to make this situation still more confusing, the numerous metals and alloys in their numerous fabricated forms are finding themselves facing stiff competition in many cases with a rapidly growing number of remarkably versatile products of industrial chemistry, many of which were unheard of a short time ago, some even being products of the farm.

An important conclusion—and one of decided significance to parts makers

BOLTS
NUTS
RIVETS

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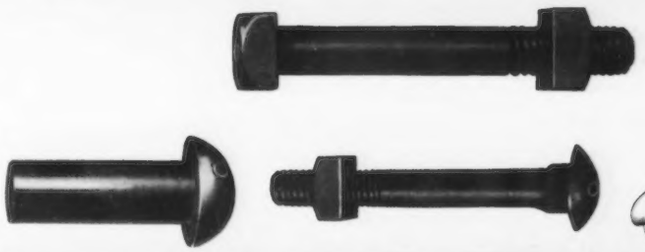
FOR THREE QUARTERS OF A CENTURY!



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Every piece illustrated represents a design or production problem solved—many highly involved. Hubbard has made thousands of parts like these in all kinds of shapes and materials.

Hubbard's long experience, skill, extensive facilities, and modern equipment, can work out the right part essential to your design or production scheme.

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Grammes has been in the business of manufacturing metal products for over 62 years

We have large and efficient facilities for producing metal products of unusual character, employing within one building the widest range of services — *metal stamping, wire forming, embossing, etching, lithography, coining, enameling, welding,* all types of *plating* including the very latest development of *electro-color plating,* and have our own *tool, machinery, art, research laboratory,* departments.

We have consistently served many leading industries in volume production on difficult, exacting and quality specifications.

Consult Grammes about metal products, particularly if they call for craftsmanship and the unusual in finish.

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SPRINGS
FOR EVERY MECHANICAL NEED
COIL SPRINGS
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WIRE FORMS
STRICT ADHERENCE to specifications is a fundamental policy of "American". When you buy American springs, you can be sure that each individual spring will be made in exact accord with your original design—to specified dimensions, tolerances, strength and resiliency.
SNAP RINGS
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from Every Type of Wire up to & including ½" dia.
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AMERICAN SPRING
AND MANUFACTURING CORPORATION
PARK AVE. HOLLY MICHIGAN

—which can be drawn from the industrial record of 83 years, as set forth in the files of THE IRON AGE, is as follows: That progressive industrialists —while they have not for long ignored any of the practical possibilities of the newer materials—have not thrown overboard any of the older materials which have merit. What usually has happened in the long run has been that after the initial excitement has subsided the newer materials have been quietly absorbed into the industrial structure at those points where their distinctive characteristics are most advantageous. This oftentimes has proved to be in close alliance with the older materials, aluminum-clad and stainless-clad steel sheets and chromium plating being examples.

Improvements on Older Materials

In the meantime some of the older materials as a result of the competitive pressure exerted by the newer ones, are given improved physical properties and are made available in new forms and in finer finishes. These improvements not only make them much better for their conventional applications but at the same time adapt them to new uses. Such broadened capabilities of the older materials have not infrequently made them useful to parts makers in entirely new ways—thereby opening up markets for them which more than make up for those lost to some of the newer materials.

The result of all this activity in the development and improvement of materials is that engineers and designers now have, except in rather rare instances, a choice of two or more materials of equal or similar merit for the parts which they design or specify. Through intimate familiarity with this ever widening field of engineering materials, which must include the differentials in cost, in physical properties and workability of the similar materials, alert parts makers are winning many a profitable contract and at the same time are performing professional service for their customers which will not be forgotten when the time for new contracts rolls around.

Specialists

It is a sign of the times that many of the most successful parts makers are those who are guided all the way from selection of raw material to final testing of finished product, by chemical, physical and metallurgical specialists. Larger companies maintain their own laboratories staffed by full-time technical experts. And right here is something very interesting. The formerly sequestered plant laboratory has been hit by a particular kind

of "decentralization." Many pieces of its scientific apparatus, and those who operate them, are now to be found spotted here and there out in the plant at those locations where immediate checks and tests can be made as the work flows through.

As to the smaller makers of parts, progressive ones are meeting the scientific requirements of the times by employing outside consultants on a fee or retainer basis. The recognized consultants have in many cases built up sizable staffs of experts and maintain laboratories which compare favorably in size and equipment with those of the largest manufacturing organizations.

Another important form of professional service now available both to large and small manufacturers of parts, is that maintained by important materials suppliers for the benefit of their customers. The certified steel plan recently put into effect by one of the supply houses is an example of this, and reflects the ever growing tendency of the really important buyers of parts to specify exact analyses and treatments on their orders. Inasmuch as these same companies subject the parts to rigid tests and inspection upon delivery, "rule-of-thumb" methods in parts making cannot be tolerated any longer.

Marketing Angles

In discussing various marketing angles with a number of representative makers of parts, the following point was stressed: That parts makers today are having to deal with an increasing number of purchasing agents who have had engineering training, who have engineers associated with them, or who work in very close cooperation with the chief engineer of the company. While this does not mean that price and delivery are not still important, it does mean that those factors no longer are everything.

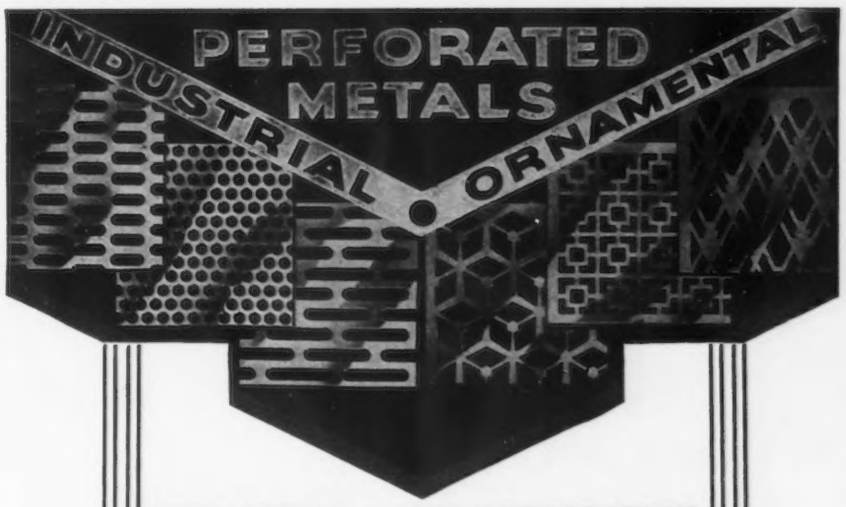
These engineering minded purchasing departments fully understand the exacting specifications which they handle and in which they have oftentimes had a hand in drafting. They can detect whether would-be suppliers know what it is all about and whether they are likely to be able to live up to the specifications. They know the difference between wild quotations based on hunches and guesswork and sound quotations based on knowledge of materials, manufacturing methods and costs.

Furthermore, these purchasing engineers are quite likely to appear unexpectedly at the plant of a supplier or would-be supplier of parts, to observe at first hand the engineering

Your spring troubles vanish (along with our hair) when you seek a DUNBAR solution. That's why we keep adding younger, bushier heads to our organization—so you'll never be without a source of springs and wire parts, when you need them.

DUNBAR BROS. CO.

DIVISION OF ASSOCIATED SPRING CORPORATION BRISTOL CONNECTICUT



ANY METAL • ANY PERFORATION

• The H. & K. line of perforations for industrial purposes includes a great variety of sizes and various shapes designed for efficiency and adaptability.

Ornamental perforations embrace many original and exclusive patterns as well as the standard designs.

H. and K. workmanship is unsurpassed.

Write for information.

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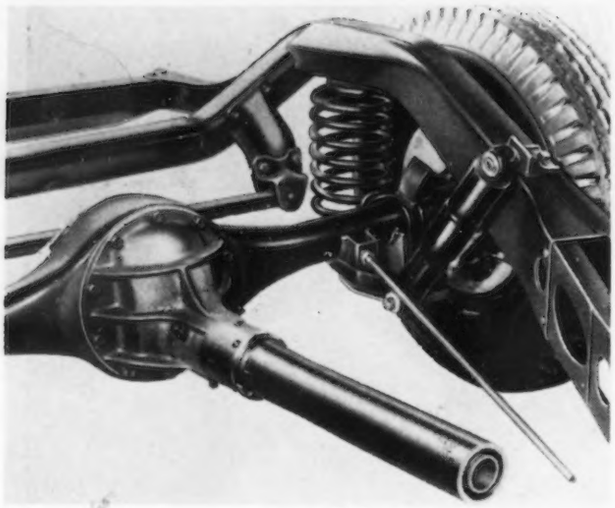


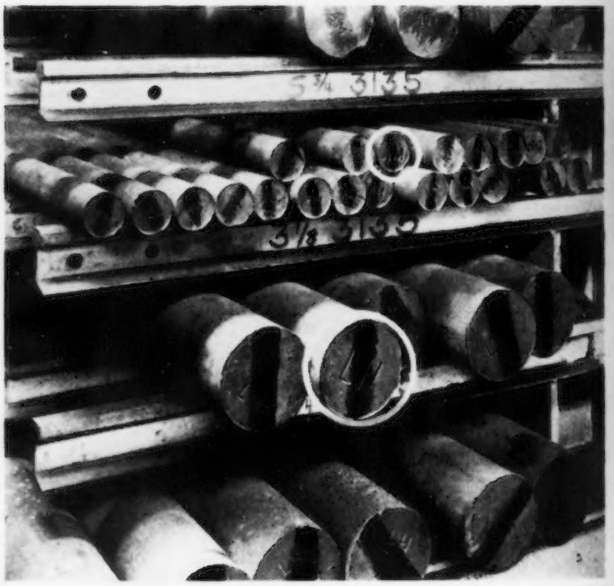
EACH year new applications expand the spring market. Typical is this knee action rear end on the new Buick.

and manufacturing set-up. The result has been a general cleaning up of parts making establishments. Today most of them are models of good industrial housekeeping.

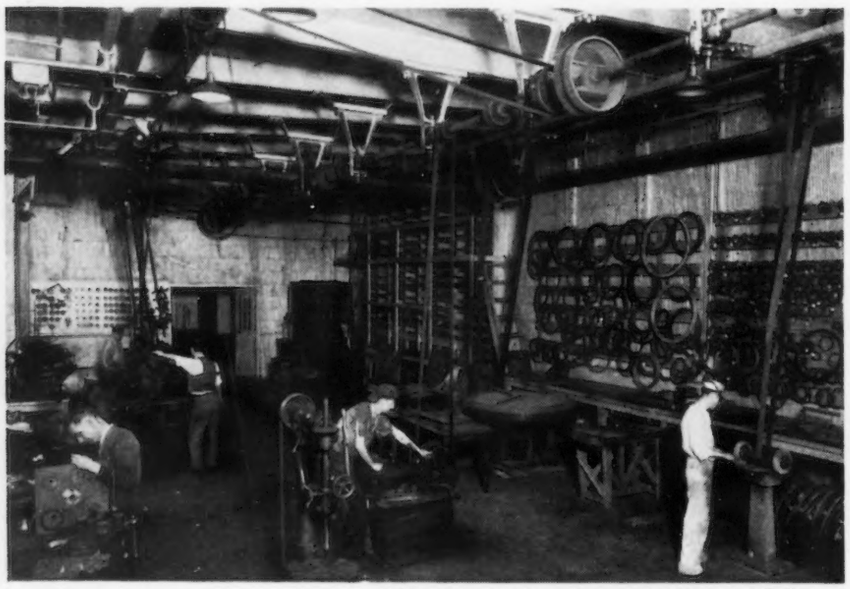
Screws, Bolts and Nuts

In an attempt to touch upon a few of the high spots in development in the wide field covered by this subject of parts for the trade, suppose we give consideration first to those old standbys, screws, bolts and nuts. Once the stronghold of the automatic screw machine, manufacture of these important fastening elements is now divided between the machining and the forging processes. Refinements in both systems now make it possible to produce these parts at tremendous speed even from the tough materials now so frequently specified. Whether "milled from the bar" or formed in dies they can be held to split thousandths when such extreme accuracy is required. Finish, and threads—regardless of whether cut or rolled—will pass that microscopic examination to which users subject them.

The strength of modern screws, bolts and nuts is due fully as much to improved mass methods of heat treating as it is to the better raw materials available. To one who may not have visited a screw plant recently, the heat treating department—with its continuous furnaces, its quenching equipment, its instrumentation and associated automatic control, and its cleanliness—will be a revelation.



HEAT symbols certify to the composition of alloy bars under the Ryerson steel certification plan.



(Courtesy American Hammered Piston Ring Co.)

PISTON ring making is an example of specialized parts production.

Special Fastenings

One of the significant trends in the field of fastenings is the recent rise of a number of special types and types not common a few years ago. Among the latter are the several makes of hollow cap and set screws. The idea of the hollow screw was conceived originally as a safety measure in connection with set screws. The greatest impetus has been given to the idea more recently, however, by the growing demand for smoothness in design—frequently called "streamlining." These screws, the hollow head cap screws in particular, make possible the strong connecting of parts without

SPECIAL BOLTS

FOR MANY of today's high pressure and temperature requirements "off the shelf" bolts, studs, and pins simply will *not* do... For 25 years, designing engineers have specified Erie's Carbon and special Alloy bolting... Why?... Because these men responsible for *safety in performance,* know that Erie meets their specifications accurately... They know Erie's development of special threading, special alloys, *unswerving precision,* assure that extra safety factor absolutely necessary in today's bolting applications. Erie's catalog features 2 new ...ently developed, high-...

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breaking the smooth continuity of surface favored by industrial stylists. For this reason, and because of their all around utility, the manufacturers of these screws—who are doing an outstanding job of industrial marketing—have increased their business by leaps and bounds. Recent standardization of sockets, making the hexagonal and the fluted wrenches interchangeably workable, has helped this business considerably.

Of the special types of fastening elements which are assuming importance, here are a few typical examples: Hardened drive screws and self-tapping screws useful respectively in rapid fixed and removable assembly not only of sheet and pressed metal, die castings and plastics but of some tougher and heavier materials as well; grooved drive pins for which no reaming is required; nuts with "built-in" friction locking elements which make them hold tight in spite of severe vibration; resilient lock nuts pressed from sheet metal; spring steel self-locking "speed nuts" which can be snapped into place in a fraction of a second; multiple-tongue spring lock washers; helical type spring lock washers featuring increased power and range of action; and a structural rivet-bolt with ribbed drive body and Dardelet self-locking thread.

Cold Formed Parts

Screw machine products of special design made to customers' specifications long have been and continue to be manufactured by parts makers in a wide variety of sizes and shapes. Not so well known is the increasing amount of special work being done by those parts makers who are equipped with cold forming machinery. This work, which now is being cold formed to customers' specifications, is of endless variety, ranging all the way from a rod with a simple head or an eye formed at one end, to complicated shapes such as automobile door handles.

If any user of variegated parts in quantities will take the trouble to look over the latest sample boards of cold formed special parts, he will see many which resemble his own parts which he may be having made by slower and more expensive methods. Designers who are developing new products for large scale production should become better acquainted with the new possibilities of cold formed parts.

Drop Forgings

Drop forgings, which are among the oldest of the commercially produced parts, are still widely popular after 80 or more years. In spite of increasing competition with press forgings, heavy gage formed parts, and steel castings, drop forgings hold their own as parts for hand tools and heavy duty hardware specialties of high quality, as tool posts and tool holders for lathes and some of the vital parts of bicycles, motorcycles, automobiles and trucks, and of aircraft engines.

They also are being used in connection with structurals, pressed steel members, etc., into which they are incorporated by gas or electric welding. In this way large parts which otherwise would require large, expensive dies and heavy duty steam or air hammers, can be built up from relatively inexpensive details. There are possibilities here for those forging and press shops whose lack of big equipment has kept them from bidding on

Keep the Wheels Turning

With electricity doing the major production tasks in all industries, the use and maintenance of positive, accurate, unfailing electrical control equipment is vital. Commercial manufacturers of instruments, controls, devices and appliances, as well as industrial plants that produce their own equipment, find INSUROK, in sheets, rods and tubes, the indispensable, ideal plastic for every electrical requirement.

INSUROK
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OF known physical, chemical and dielectric qualities, INSUROK offers many advantages. The standard insulating material, INSUROK, is non-hygroscopic, retaining its insulating properties under varied climatic conditions. It resists the destructive action of corrosion, oils, solvents, greases, most chemicals, acids, reagents and other liquids. It is tough, durable, hard, light in weight. Possessing extreme workability, it can be adapted to every electrical need from an almost microscopic part to a giant control panel. Get all the facts about INSUROK—the versatile plastic—for scores of profitable uses in all industries. Literature on request.

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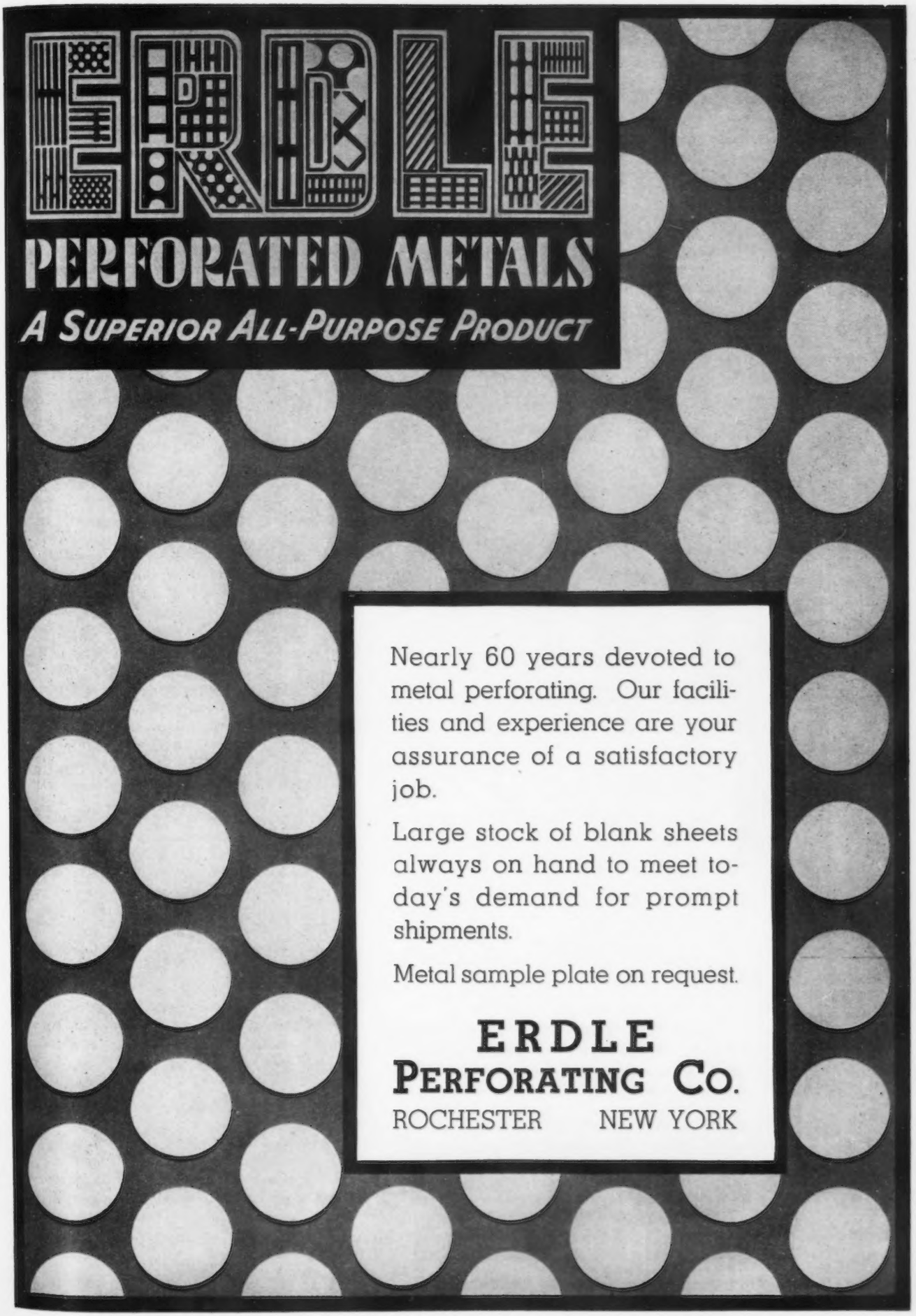
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PERFORATED METALS
A SUPERIOR ALL-PURPOSE PRODUCT
Nearly 60 years devoted to metal perforating. Our facilities and experience are your assurance of a satisfactory job.
Large stock of blank sheets always on hand to meet today's demand for prompt shipments.
Metal sample plate on request.
ERDLE
PERFORATING CO.
ROCHESTER NEW YORK

large work. Another factor which opens up new possibilities to the makers of drop forgings and even some of the heavier die forgings, is the coining press method of finishing to exact dimensions. This method can often be made to eliminate secondary machining of spottings, pads, etc.

Die Castings

Next let us consider die castings. Here is another industry in which the metallurgists and the die specialists have lately done a great deal to develop. Much credit also is due the makers of die casting machines. As far as the rapid improvement in quality of die castings is concerned—and their corresponding acceptance by industry—the "institutional" efforts made lately by large producers of aluminum, zinc and other basic metals used in the die casting alloys, have been of tremendous importance in three ways. One way has been in the education of die casters toward the making of stronger and finer castings; another has been in the promotion of the use of die castings by large producers of mechanical products; the third has been in the education of the public toward acceptance of—and even demand for—die cast products or products including die castings.

The last two ends are being achieved to a considerable extent through generous use of "institutional" advertising—in which an outstanding job is being done. Another factor favorable to the die casting industry has been the swing toward "styling up" of formerly drab appearing manufactured articles. The industrial designer finds in die castings an effective medium for artistic expression.

Plastics

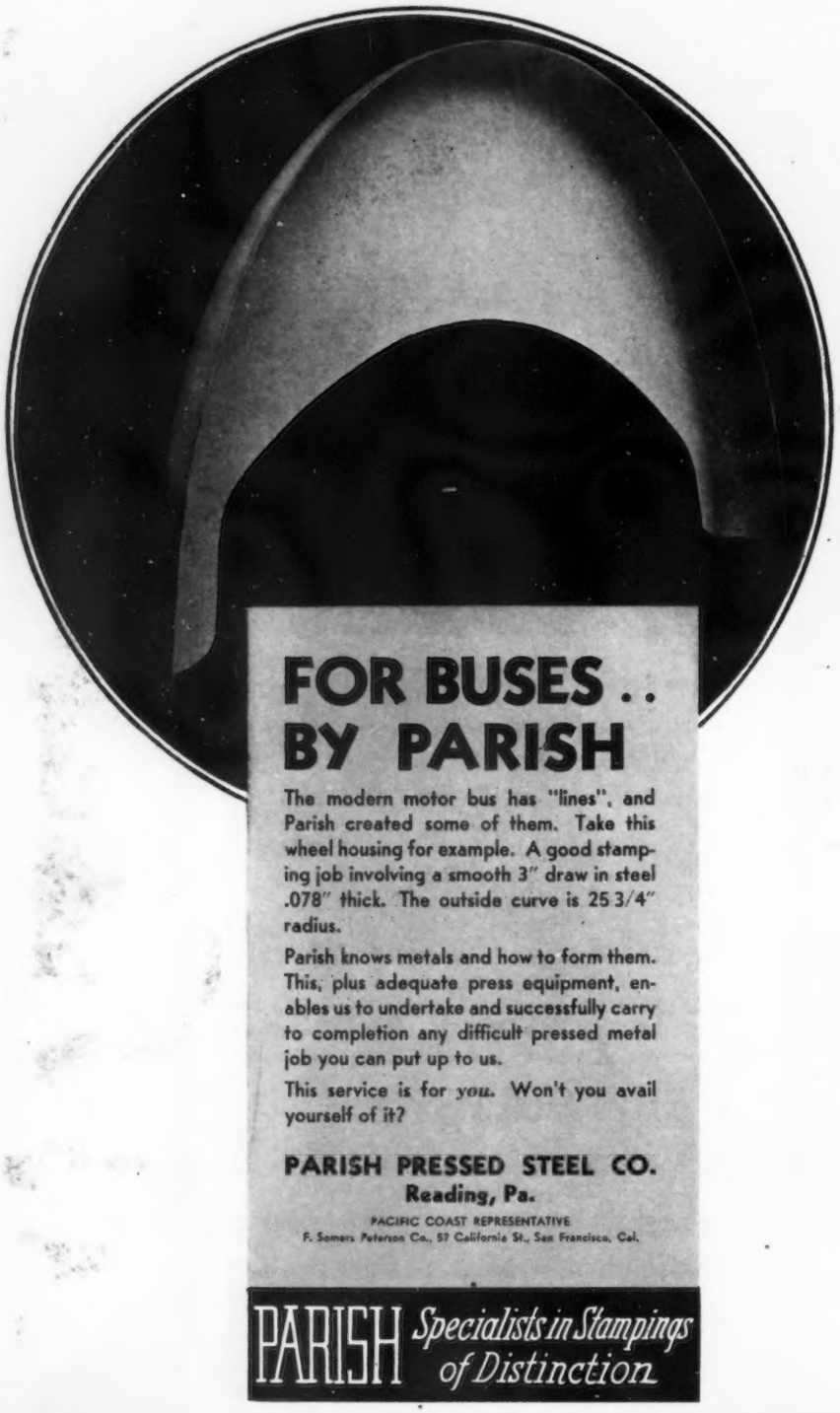
The last of the die formed parts which we will consider here are the plastics. This is outside of the metalworking field, and is an extremely specialized subject—dealing as it does to such a large extent with organic chemistry. However, as something which ties into and in some cases competes with the metal working industry in the realm of parts making, it certainly deserves thoughtful attention in this review.

In the United States the production of the synthetic resins has increased at least 125 times since 1921 and the volume still increases. At the moment this represents a business of over $50,000,000 annually and an output of as much as 150 million pounds. That a lot of this is going into parts for the trade is indicated by the fact that there are today at least 115 customs molding companies actively engaged in the production of plastics parts; more than 100 fabricators; and over 80 industrial designers who specialize in designing and redesigning products for the use of plastics parts.

The most widely heralded achievements in plastics during the past year have been the successful commercial production of large press molded parts, including cabinets for console radios and housings for business machines. Less spectacular, but of far greater technical significance, are the hundreds of smaller parts such as steering wheel rims, dash board details and moldings for windows, which are used in conjunction with metal parts —resulting in assemblies of new utility and beauty.

Bearings

Progress in anti-friction bearings during the past year has been marked


FOR BUSES . .
BY PARISH
The modern motor bus has "lines", and Parish created some of them. Take this wheel housing for example. A good stamping job involving a smooth 3" draw in steel .078" thick. The outside curve is 25 3/4" radius.
Parish knows metals and how to form them. This, plus adequate press equipment, enables us to undertake and successfully carry to completion any difficult pressed metal job you can put up to us.
This service is for you. Won't you avail yourself of it?
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PARISH Specialists in Stampings of Distinction

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The steel used in the making of Standard products is acid open hearth, produced in our own furnaces under close metallurgical control.
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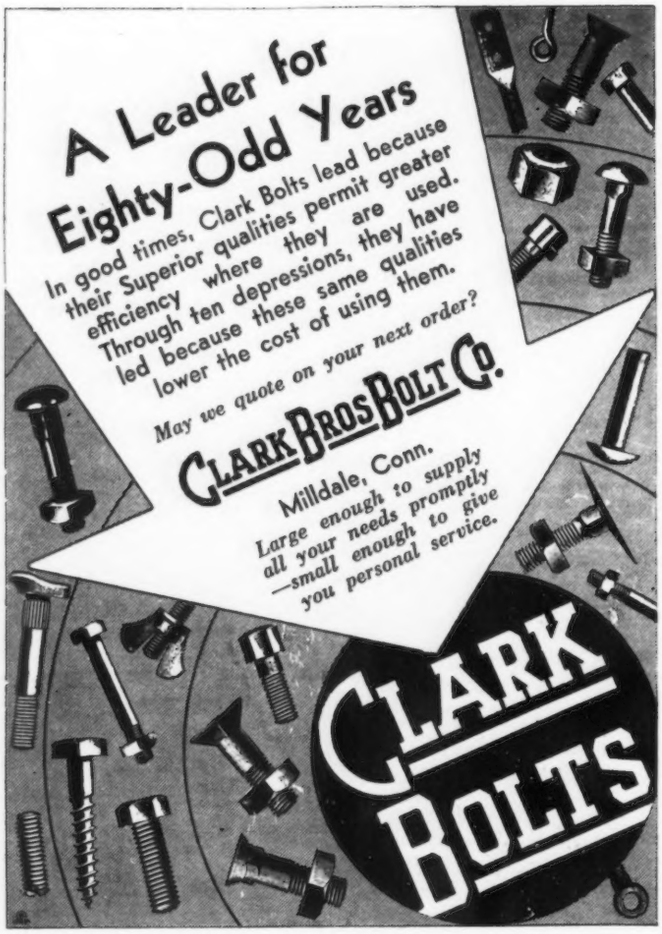

A Leader for Eighty-Odd Years
In good times, Clark Bolts lead because their Superior qualities permit greater efficiency where they are used. Through ten depressions, they have led because these same qualities lower the cost of using them.
May we quote on your next order?
CLARK BROS BOLT CO.
Milldale, Conn.
Large enough to supply all your needs promptly —small enough to give you personal service.
CLARK BOLTS

by a number of refinements in—and by broadening lines of—standard units of cartridge type. Lubricant sufficient for the long life of the bearing is sealed in by sealing units which are integral with the bearing assembly. There also have been improvements in commercial type needle bearings, accompanied by active sales engineering efforts, resulting in the successful application of needle bearings in confined spaces—especially those where the duty is heavy and attention difficult. These applications have ranged all the way from roll necks in steel mills to tiny cam rolls, and have resulted in some machines finally being 100 per cent anti-friction bearing equipped—right down to the last obscure rocking lever.

Plain bearings in the meantime are giving an excellent account of themselves, with improved babbitts and bronzes, finer finishing methods, and increasing use of unfailing systems of centralized lubrication all helping their cause most decidedly. In the field of self-lubricating and oilless bearings and bushings, those made of phenolic plastics should now be counted as active members of that family

They **STAND** *the Strain!*

Any springs you might pick up would look all right in the hand, but when subjected to full load in tension, torsion or compression — that's where "AMERICAN" springs reveal a uniformity that reflects the aims and achievements of the American Spiral & Mfg. Co.

The use of high grade wire, modern spring machines, correct heat treatment and 50 years of specialized experience make "AMERICAN" springs what they are—dependable.

★ *Buy "AMERICAN"* ★

AMERICAN SPIRAL SPRING & MFG. CO.

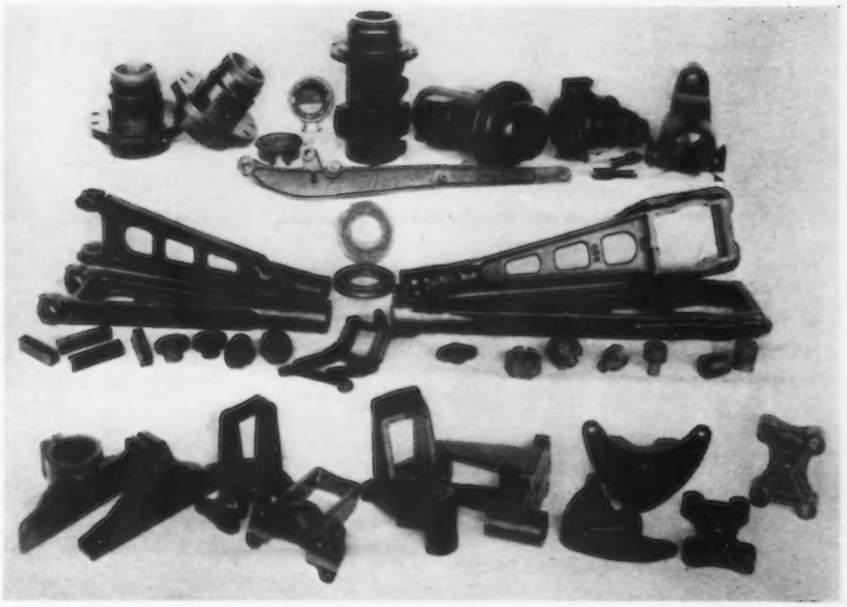
5540 HARRISON ST., ★ ★ ★ PITTSBURGH, PA.

already including graphite-impregnated metal, plug lubricated metal, lignum vitae, etc.

Shaft sealing units are now available from stock in a wide variety of easy-to-install types and sizes. By keeping lubricant in and dirt out they are an important factor in making it possible successfully to use the finest types of bearings under what just a short time ago would have been absolutely impossible conditions. In connection with these seals, watch for interesting applications of seamless accordion-type metallic bellows material; improved oil resisting natural rubber, and products such as neoprene and thiokol. The last three, incidentally, are also highly important in many recently developed noise and vibration-damping parts, some of which are standardized units.

Gears

And finally, what about the gear business? Years ago, Grant—one of the pioneer gear specialists and manufacturer of gears "for the trade"—wrote a popular treatise on the subject of gears. At the beginning of the first chapter he placed that familiar old quotation about the "primrose by the river's brim." The implication was that to the average machine builder of that day any gear ". . . was just a gear to him and it was nothing more!" Grant, and a long line of gear experts and makers of gear manufacturing machines and tools, have since



MALLEABLE castings are part of the parts business. Here are the castings required to convert standard trucks to six wheelers.

QUALITY CASTINGS SINCE 1905

MOUNT VERNON DIE CASTING CORP.
MOUNT VERNON, N.Y.

This die mark is a mark of Quality Die Castings

Our engineers have had years of experience in designing parts to be die-cast, building dies and producing the die castings. They are entirely familiar with the alloys available, and are prepared to furnish you with the particular alloy of zinc, aluminum or magnesium which will best suit your application.

With this accumulated knowledge and experience, we continue to serve every industry, and we solicit your inquiries with the confidence that we can serve you well.

We would appreciate an opportunity to make quotations on your die-casting applications. Either a model or blueprint will suffice.

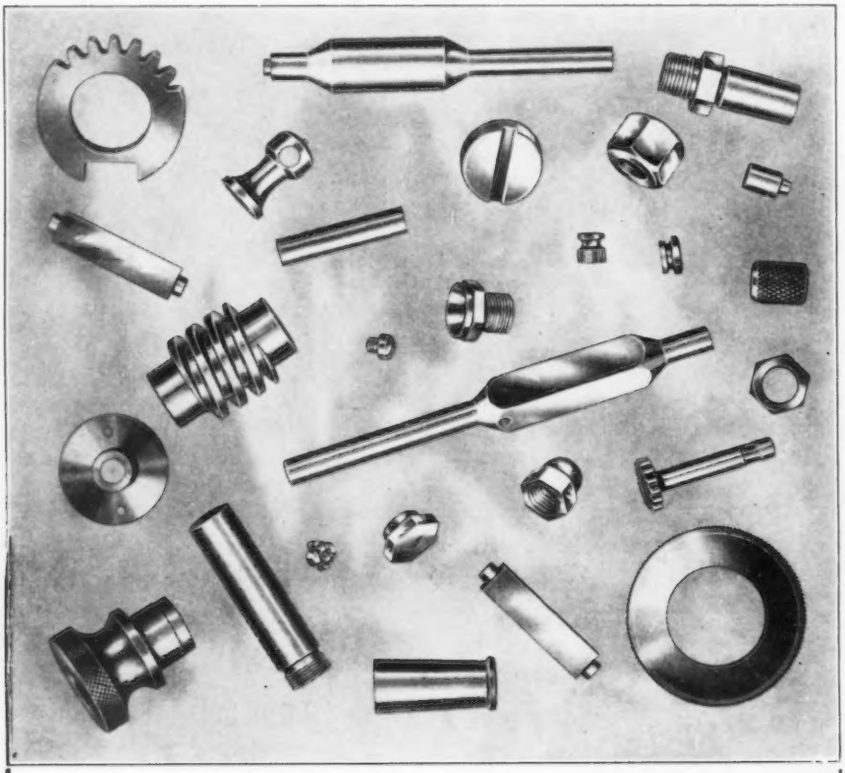
MOUNT VERNON DIE CASTING CORP.
Mount Vernon New York

labored long and hard to do away with such casual treatment of gears. As a result the voice of the modern automobile is a soft purr—something very different from the ugly snarl of its ancestors.

With the constant improvements in gear design and even more recent refinements in gear manufacturing and finishing methods, it has become next to impossible for the average machinery manufacturer to keep up with the design developments—much less to have at hand the constantly improved shop equipment—involved in this fast moving business of gear production.

That is where the custom gear makers come into the picture, in a big way. The manner in which they are handling it can well be compared to the outstanding job which has been done by the ball and roller bearing industry.

WELDED steel and cast iron machine base supplied to National Acme Co. by Taylor-Winfield Corp.

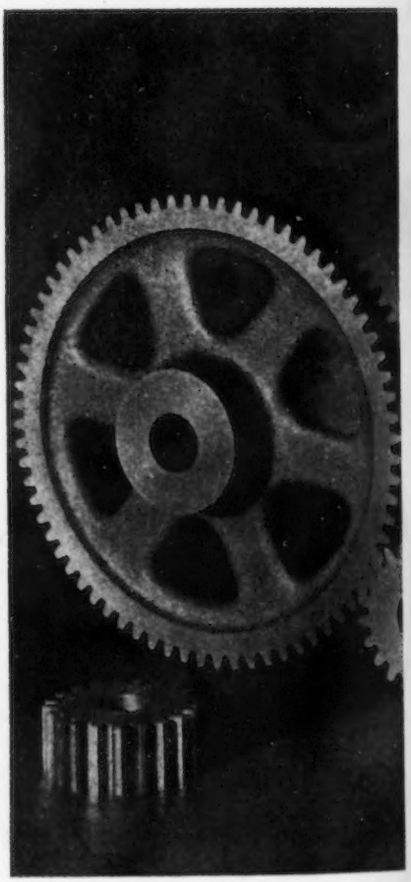


1913 - 1938

To you who have made our steady growth for the last twenty-five years possible, many of whom have been with us since the beginning, we express our sincere gratitude.

OLSON MANUFACTURING COMPANY
WORCESTER, MASS.
New York Philadelphia

Screw Machine Products



(Courtesy Horsburgh & Scott Co.)

GEAR making still occupies a prominent place in the business of parts and products.

Cleaning AND Finishing

METAL

Cleaning AND *Finishing*

Developments in plating, cleaning, lacquering, etc., and in methods of application now make possible almost any finish the fabricator may imagine or ask for.

° ° °

By HERBERT R. SIMONDS

° ° °

MOST of us, observing a burned out and blackened light bulb, give no thought to the process which blackened it. We know by having felt the smooth exterior that the black coating is on the inside, but we are so familiar with dirt which settles on glass that the fact that this particular dirt came from a tightly sealed vacuum interior, which once was spotlessly clean, does not arouse our curiosity.

Yet, one research worker at Cornell did pause to consider this familiar phenomenon. He reasoned that the black coating must have come from the metal filament, for there was no other dirt source. Here, then, was a new method of plating. Increase the size of the vacuum chamber, substitute chromium or nickel for the tungsten of the filament, place objects to be plated inside the chamber and the process becomes useful. Such a process actually came into successful commercial existence during 1937, a year featured by commercial developments rather than by inventions. Chief of the commercial achievements in metal finishing were: electrodeposition of tin, electro-color plating, and plating of aluminum on steel.

In the organic plating field, plastics coatings, reported a year ago as a laboratory development, found commercial application on a large scale as

AUTOMOBILE door handles are given a thick coat of a plastics finish—Macoid—on rotating dip units such as this. The bars, each holding 20 handles, are removed in a unit for transfer to subsequent operations.

o o o

THIS large cast steel basket for use in a centrifuge was chromium plated at the plant of the Philadelphia Rust Proof Co. Note that axis is mounted above tank and that plating is accomplished by rotation of basket.

o o o

finish for automobile hardware. Important advances were made in the production of heat resisting and acid proof lacquers, in the development of one-coat elastic enamels and in the design of automatic coating equipment. Today, as one lacquer man said: "Practically any finish a metal fabricator could ask for is ready if he only knows where to get it."

In preparing this review, more than 500 companies in the metal finishing field were approached for comment on the outstanding developments of the year.

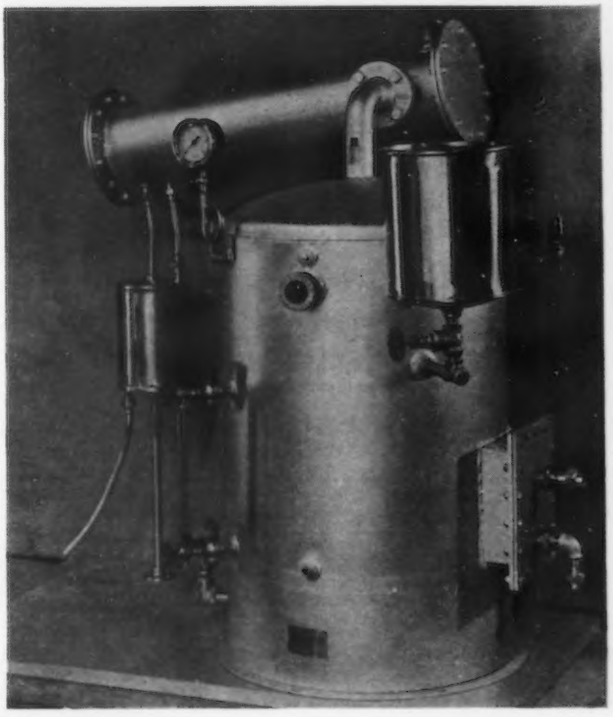
Nearly 100 companies participated in this review, but as expected, those sponsoring a particular product or process were inclined to give it considerable emphasis in their record of the year's progress. However, this was not always the case and, as many of the opinions were from neutral sources, the following summarizations may be considered a fairly representative cross section of opinion.

More companies mentioned bright nickel plating than any other subject. Dr. Colin G. Fink, of Columbia University, who has contributed to this review for many years, feels that the development with the greatest commercial significance during the past year was electro-tin plating. He states: "The electrodeposition of tin is now

AT RIGHT

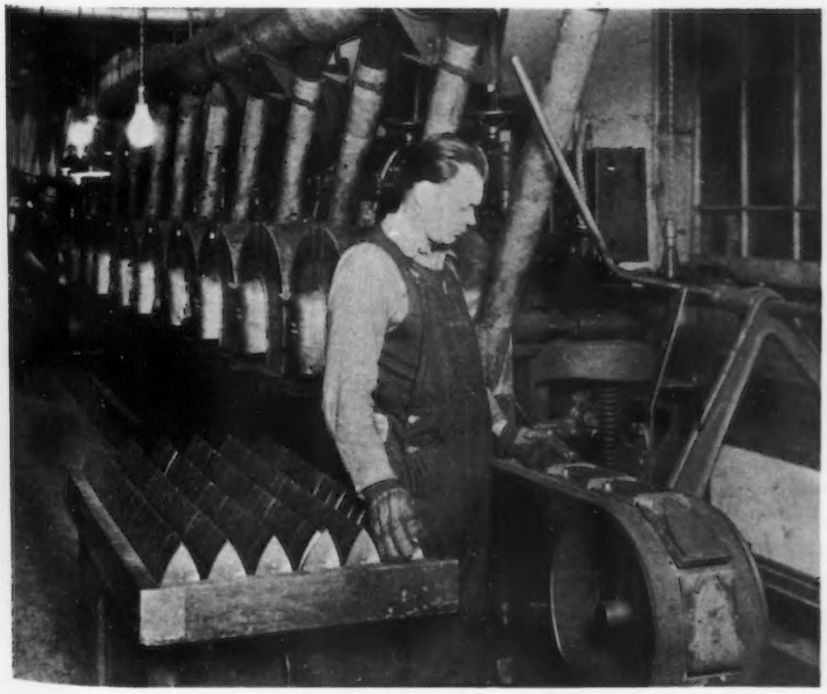
THIS compact equipment is for reclaiming solvents after use in metal cleaning.

o o o



BELOW

ENDLESS belts with metal jigs attached simplify polishing of flatiron bases at the plant of the Edison Electric Appliance Co., Ontario, Cal. Production rate is 2000 pieces per hour.



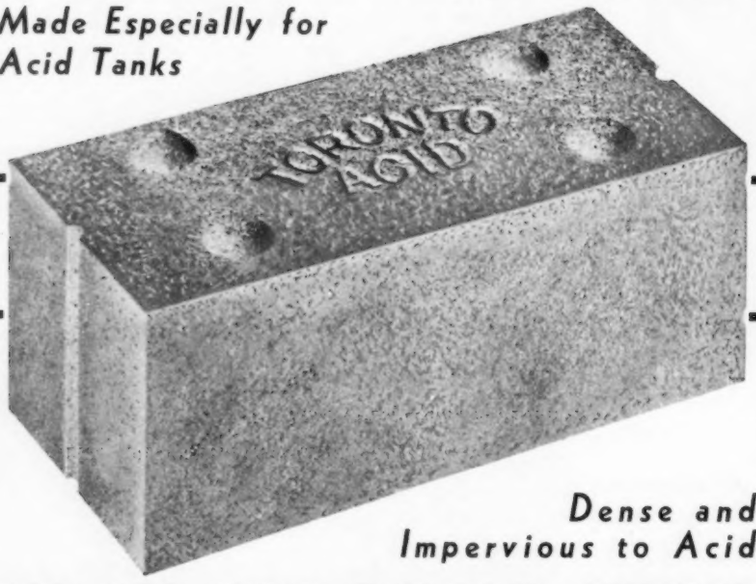
an established practice and the question before the whole tin world is whether old hot dip tin mill equipment should be abandoned to make way for the adoption of new. There is no doubt that 1938 will see big changes in the tin plate industry.

"The general trend throughout the electroplating art has been toward bright deposits, with the complete elimination of buffing or 'coloring,' as it is technically termed. Among the relatively recent newcomers we have bright tin, bright nickel, and bright zinc; whereas bright chromium, bright rhodium, and bright copper are well established.

"New evidence has been brought forth during the past year that iron and steel can be protected with thin coats of noble metals, electrolytically applied—metals which heretofore have not even been considered feasible or practical. Thus, of special interest re-

TORONTO ACID BRICK

Made Especially for Acid Tanks



Dense and Impervious to Acid

FOR USE WITH BASOLIT CEMENT

Toronto Acid Brick are designed for use with Basolit, the acid-proof cement joint. Accurate spacing buttons and end grooves insure uniform self-anchoring joints at low labor costs for laying up tank walls and floors. Precisely moulded, repressed and deaerated, Toronto Acid Brick are made in stock and special shapes. Send for samples and further information.

THE KEAGLER BRICK COMPANY

STEUBENVILLE, OHIO

Fire Clay, Acid Resistant Brick, Fire Clay Mill Brick, Pickling Tank Linings, Acid Proof Construction, Paving Brick, Paving Block, Chimney Stack Brick.

BASOLIT *Protected* **PICKLING TANKS**

Courtesy of The B. F. Goodrich Co.

The above picture shows a double line of continuous strip pickling tanks recently installed in one of the largest steel mills in the country. The tanks are of rubber lined steel protected with a double sheathing of acid brick and BASOLIT.
The installation illustrated is one of many hundreds where BASOLIT has contributed toward long life and efficient operation of modern pickling equipment.

NUKEM PRODUCTS CORP.

BUFFALO, N. Y.

NEW YORK **PITTSBURGH** **DETROIT** **KITCHENER, ONT.**

cently is the protection of iron and steel with a thin coat of silver."

Another development which is casting its shadow on raw material sources is the trend, in metal parts cleaning, away from the now predominant alkalies and toward the use of new chemicals and new theories of scale and dirt removal. Thus, here, as in so many avenues of industry, the chemist has stepped forward to a place of importance, scarcely second to that of the metallurgist or the engineer.

Chemistry to the Fore

Research workers in the realm of electroplating and of synthetic lacquers have been active, but their chief attention has centered on bettering existing processes rather than on new inventions. Nevertheless even in creative work metal finishing has held its own in relation to the total art of manufacture and fabrication of metal, for of five inventions placed on the honor roll by the President's national resources committee during the year, two refer to metal finishing. These were aluminum coating of steel and the molten spray method of metal coating. The other three awards of this committee were for the electrolytic process for utilizing American low grade manganese ores, the high frequency electric method by which sheets may be welded together at a rate of 60 ft. a min. and the direct rolling of sheets by pouring molten metal between water-cooled rollers.

The fact that new processes in metal finishing seem to have been fewer in 1937 than in the immediately proceding years does not mean that there has been any general slowing up of progress in this field. If anything, the total activity has probably shown an increase commensurate with the modest increase in general manufacturing operations. The electroplating of zinc on steel strip and wire has not progressed as fast as had been expected, but certainly interest in this method of finishing is keen and as soon as some further cost analyses are made, wider application may be expected. On the other hand, bright zinc plating has made unexpected progress and has replaced cadmium to such an extent that very little cadmium for appearance is being used today.

One of the important developments of the year was the introduction into this country of the method of building up worn parts with electrodeposited nickel. This has been done successfully in England for some time, but not until late in 1937 was it introduced on a commercial scale here. When a prominent manufacturer was asked why the United States had apparently overlooked this method, his

answer was that labor skilled in this particular line was far more expensive here than in England.

Expansion Shown

Most branches of the electroplating industry have shown steady expansion according to the statistics of the Bureau of Census, and in several divisions of the industry increases above the 1929 level were reported. The value of products on contract work (in so-called jobbing shops) was a little over $18,000,000 in 1935 compared with $10,000,000 in 1933 and $23,000,000 in 1929. The number of establishments in 1937 showed an increase over the number in 1929, however, and in the absence of government figures as to the value of products in 1937, estimates based on the consumption of nickel, chromium, and zinc indicate that the 1929 level has now been reached.

The production of galvanized plates, sheets and strip has increased surprisingly during the last few years and is now well ahead of the top figure in 1929. According to government statistics the increase from the low point in 1933 to 1935 was almost 100 per cent. Corrugated galvanized sheet production in 1935 totaled $27,000,000 as against $26,000,000 in 1929. In addition to the above, the galvanizing industry, as it exists independent of steel works, had a value of products in 1935 of about $4,000,000. Statistics covering lacquering and enameling are difficult to obtain as these operations are grouped with stamping and forming in government reports. An estimate based on figures of several lacquer manufacturers gives a total production of organic coatings in 1937 substantially ahead of the 1929 figure. This increase is particularly apparent in the case of synthetic lacquers. One manufacturer hazarded the guess that this branch of the industry alone would total close to $50,000,000.

Color is Popular

A strong consumer interest in color was evident in metal products during the past year and many interesting color processes came out of the laboratory, including color plating already mentioned. Even aside from that process it is safe to say that almost any desired color or color combination can be secured on any metal by a combination of plating and chemical coloring. Thus, if a certain blue is desired on steel, the steel may be first copper plated and then the copper coating may be colored blue by chemical treatment with potassium and ammonium salts. The question today is not so much what color can be used, as it is, what is the cost and what is the sales appeal.

The following comment covering recent activity in the pickling and cleaning field is from W. I. Sivitz, manager, Pittsburgh district office, Duriron Co., Inc.:

"The year was noted more for the intense application of equipment developed during the past five years than for anything startlingly new. The continuous strip mill pickler has been improved. The unusually severe corrosive conditions set up in these picklers have created a demand for alloys of greater acid resistance and better physical properties. Several new uses for long known alloys thus came to light.

"Carbon tank linings have found their severest trial and have proved most practical. Their refractory properties long have been known, but the application of carbon built up as a

HOW'S THAT AGAIN?

You couldn't produce better metal cleaners at double the price?

A familiar saying, Mister Manufacturer—and a true one. The "Wyandotte" brands are doing these things—NOW.

They work fast—generally with an ample margin of the time allowance to spare.

Solutions hold strength exceptionally well—reducing the requirements for up-keep, and simplifying control.

They give chemically clean surfaces at a low unit cost—with rejects at a uniformly low percentage.

●

Personal Service is always available. May we co-operate with you?

THE J·B·FORD COMPANY
WYANDOTTE MICHIGAN

masonry wall using regular brick shapes is indeed very recent and has made possible the use of suitable acids for the pickling of stainless steels. In addition to this a new technique in masonry requiring the use of several bonding materials has been created.

"Perhaps the newest thing on the horizon is the pickling of strip in coil without unduly sacrificing the speed and efficiency that may be had by the use of the continuous strip pickler. This method of pickling is so new that it may be truthfully called a process belonging entirely to 1937. The loose coil is slowly rotated on a mandrel driven by an electric motor, and hot acid is rapidly circulated through the loose wraps by means of an agitator or propeller.

"The cleaning of strip steel to free it from dirt and grease, using alkaline and soap cleaners, is old practice, but the use of electric current in this process to speed it up is new. By this means strip can be made to travel through an alkaline bath at a rate of 900 ft. per min. allowing only 10 sec. for an effective and complete cleaning of the steel surface.

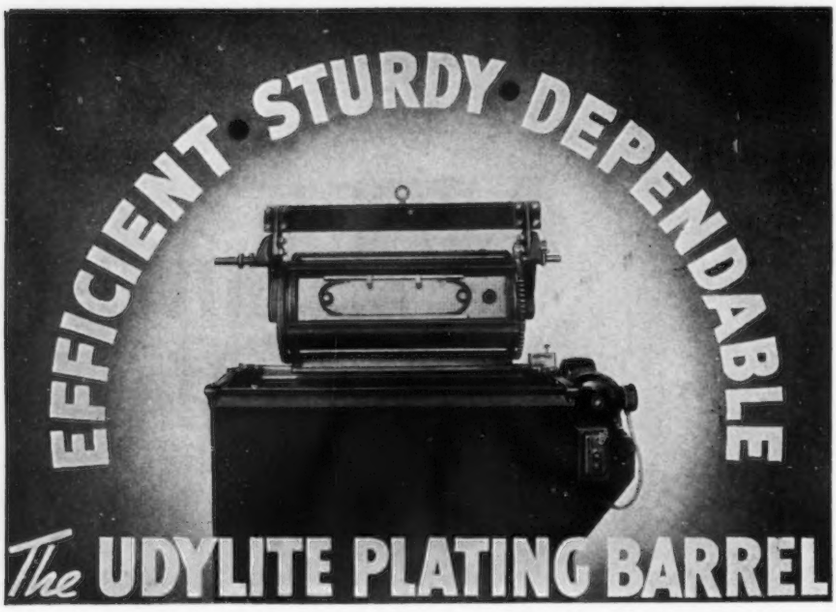
"The problem of spent acid disposal is one peculiar to the districts where the acid is to be wasted. In some districts this is no problem at all. In others, some means of disposal of the acid wastes must be worked out. Fortunately, lime is a cheap neutralizing agent and its reaction with waste sulphuric acid pickling liquor produces an insoluble precipitate of all the chief ingredients in solution. The common and best practice is to treat the waste acid with milk of lime until the iron is thrown down as the hydrate and sulphuric acid and dissolved sulphates are precipitated as calcium sulphate.

"Where a plant producing copperas is available, the waste liquor may be pumped to this recovery process, and the usual methods of recovery may be employed. All of the free acid as well as the dissolved ferrous sulphate is recovered as copperas.

"Of special interest is the possibility of recovering the copperas in solution and returning the free sulphuric acid to the pickling bath. Applying exact chemical engineering principles, the pickling process can be made part of a circulatory system from which the dissolved copperas can be crystallized by quickly cooling the bath, and the mother liquor containing the free acid can be returned for use to the pickling tank.

"Considerable pioneer work of this character was carried out a decade ago by Marsh & Cochran in the Youngstown district at the plant of the old Sharon Steel Hoop Co. This process was later abandoned, but in the year 1937 considerable interest has been reawakened and with improved modifications the process is being considered as a possible answer to a most annoying problem."

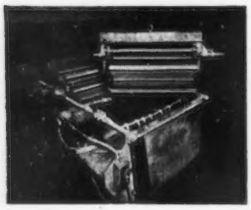
THE concluding part of this review of Metal Cleaning and Finishing will appear in a subsequent issue. In it will be described progress in plating and enameling, application of latex and plastics, developments in porcelain finishes, technique in cleaning and surface preparation, and new technical equipment.



RECORD OF PERFORMANCE

This Udylite barrel has been plating 200 lb. loads, 3 loads per hour, 18 hours per day for 7 months—no repairs.

After 8 months, 24-hour-a-day service in a job plating plant, this Udylite Barrel is still in perfect condition —no maintenance cost.



The Udylite Plating Barrel is efficient! The electrical insulation has been so perfected that all of the current goes directly to the work and "treeing" is eliminated. Steel reinforcing members and cylinder bearings are anodically charged . . . cathode leads are encased in unbroken insulation from bus bar to danglers . . . rubber panels do not absorb plating solution.

For *strength and dependability*, the Udylite Barrel has no equal. The unit is made of the strongest possible combination of materials—steel and special shock-resistant rubber. This results in a plating cylinder of great strength and resistance to rough usage.

On the basis of its remarkable performance, the Udylite Plating Barrel merits investigation. Get full details and prices by writing to the nearest Udylite office.

THE UDYLITE COMPANY

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30 E. 42nd Street	1943 Walnut Street	3756 Carnegie Avenue	114 Sansome Street

EQUIPMENT...

PLANT EQUIPMENT...

Activity in first three quarters spurred demand for industrial lighting, power plant facilities, heating apparatus and compressed air equipment.

o o o

BY ROBERT BINGHAM
Western Editor, THE IRON AGE, Chicago

o o o

FOR the first nine months at least of 1937 most industrial plants were comfortably busy. Orders were coming in at a good rate and in many cases backlogs were being built up, credit was not being abused, payments were prompt, confidence was reasonably strong, and the dreary depression years had made buyers hungry for goods of all kinds. Manufacturers found on increasing their production to meet this demand that plant facilities were not as good as they might be, that costs were higher than previously, and that new equipment was grievously needed.

The makers of this much-needed plant equipment, therefore, were favorably situated, on the whole, and with the exception of threats from labor during the spring and summer, progress was steady and so were profits, some companies indeed turning in the best three-quarters' earnings statement in their history.

Although at this writing the heavy industries have been slowed down considerably, the year even so was productive of new ideas and new developments, some of the more important and more prominent of which may be found below.

Industrial Lighting

Nineteen thirty-seven witnessed a remarkable increase in the amount of high intensity mercury arc lighting in industrial applications. The popularity of this type lamp was practically assured at the outset, in spite of its high initial cost, because it provides about double the amount of light at the same wattage as does an ordinary incandescent lamp. These mercury lamps are economically justified only when current costs are 2c. a kw-hr. or more, since a transformer is necessary for each lamp in order to stabilize the mercury arc. A further advantage is the coolness of this type light as compared with others, this feature alone being of primary consideration in several large plant installations. Last year saw the introduction of 250, 100 and 85-watt mercury lamps, where previously only the 400-watt was available.

The past 12 months also saw considerable development of glare-free luminaries for industrial lighting. The silvered bowl lamp played an important part in these installations, as did lighting units where direct light is diffused through a glass bottom, rather than being reflected against the walls or ceiling of the building, which often were too dirty to provide adequate reflection. This type of indirect light is especially suited for inspection of highly polished surfaces, such as sheets of stainless steel, or tin plate.

A marked increase has been noticed in industrial management's consciousness of better plant lighting. The slogan of the lighting industry "Better light, better sight," has been credited with some of this recognition, as has the fact that many workers in their own homes have become used to good light and so have quickly become aware of imperfect lighting at their work.

In 1938 the industry will attempt to sell the idea of "light conditioning" to owners of homes and plants.

That this idea already has made considerable progress is evidenced by the many plants throughout the country that have called in lighting engineers and had entirely new systems devised whereby production and efficiency have been stepped-up noticeably.

An all-Westinghouse installation in a recent plant expansion of the Acme Steel Co., Riverdale, Ill., has been termed by lighting engineers as one of the best industrial jobs in recent years.

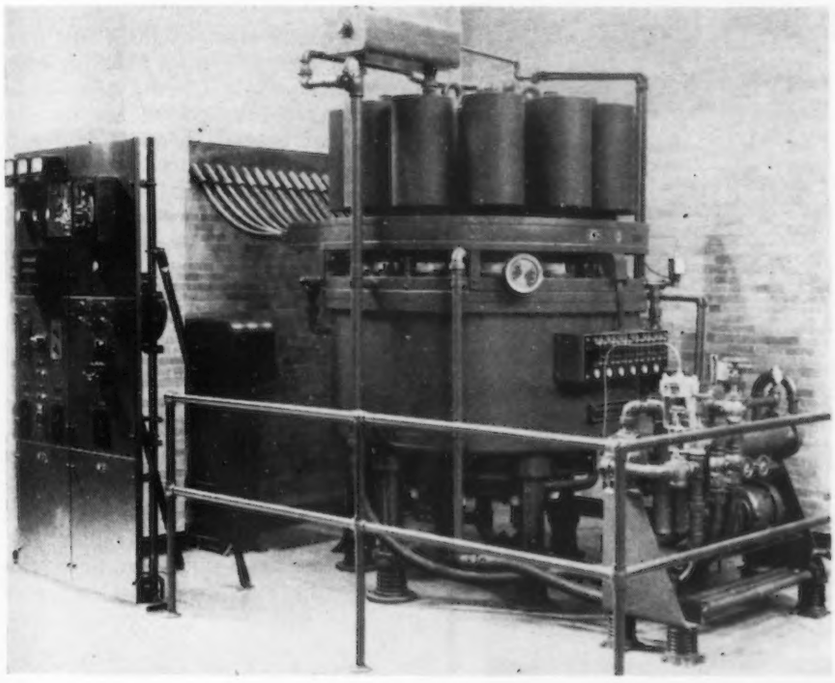
An average of 20 ft.-candles is obtained in the machine shop extension where 100 400-watt high intensity mercury arc lamps are in use. Of this number, 60 are high mounting with Alzac aluminum reflectors, and 40 low mounting with Glassteel diffuses.

General lighting is accomplished in the block-long warehouse by 800 500-watt lamps with RLM reflectors.

In the office, 150 Magnalux luminaires provide an average of more than 20 ft.-candles, while 18 high mounting Alzac reflectors for Mazda lamps illuminate the annealing department extension.

Carnegie-Illinois Steel Corp. has installed a number of heavy duty lighting units in locations where high temperatures and highly corrosive atmospheres must be endured, such as the soaking pits.

ONE of three 75,000 c.f.m. turbo-blowers at Carnegie-Illinois' new power plant at South works in Chicago.



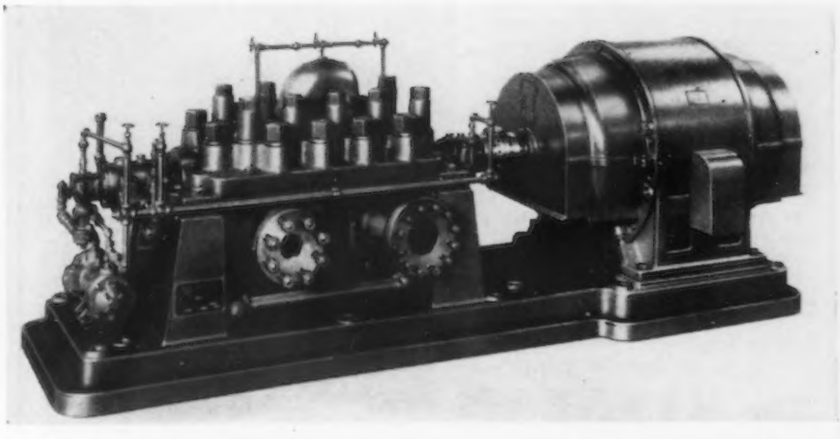
THE first mercury arc power rectifier to be installed in an American steel mill—South Chicago works of Republic Steel Corp.

Among the projects in the experimental stage which may be announced during 1938 are lamps which are operated by the phenomenon of fluorescence. In brief, this principle consists of the conversion of ultraviolet energy into visible light, it being estimated that many times as much light will be available from a given energy as from lamps now in use.

Power

In any plant the most essential equipment is that relating to power. Whether it is purchased or generated, or whether it be derived from electricity, steam or diesel, operating losses are as often found in the power division of the plant, and the operating economies are as often effected there, as in any other department.

Greater production in most plants



HIGH-PRESSURE pump suitable for steel mill descaling use.

during the year taxed power equipment to the utmost, and power plant capacity was increased in many cases by the installation of steam generators capable of maintaining increased temperatures and pressures. Although these installations have been accomplished with a minimum of building alterations, the new boilers have required changes in the manufacturing processes, development of special control equipment, and at times, the use of different and stronger metals were found necessary.

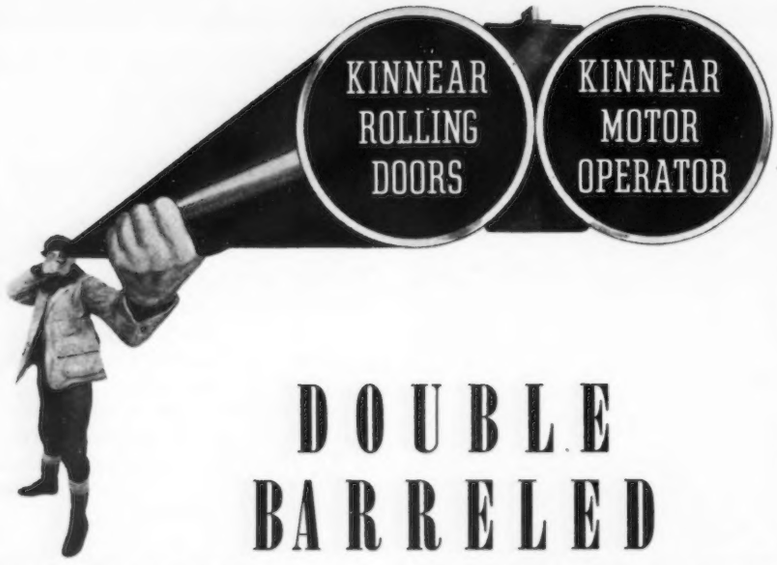
Coal burning equipment has been receiving an increasingly poor quality of coal in recent years. The working down of mines has meant that a lower grade of coal is being produced all the time, and since the power users have always bought cheap coal for economic reasons, this inferior fuel is being sent to them now. Engineers are dissatisfied, however, with this coal, and as a result screening, washing, grading, etc., have been practiced to a great extent in order to improve the quality of the coals. By these methods ash content has been reduced, heat value increased, and higher efficiency attained generally.

Since the decreasing quality of the coal was presenting rather difficult problems to engineers, this improvement has been most welcome.

Handling of coal in power plants is still mostly by means of bucket and belt conveyors with the trip from pulverizers to burners usually being accomplished by air transport. Average and small boiler establishments are finding satisfaction in the use of horizontal coal conveyors from coal bins to stoker hoppers.

A large manufacturer of power plant coal and ashes handling equipment reports 1937 sales several times greater than in 1936. The increased cost of common labor is said to be creating a market for coal and ash handling equipment in the small boiler houses consuming from one to five cars of coal daily. Much of this year's business has emanated from this type plant. Additions to existing coal handling equipment are being necessitated by the installation of more boilers or replacement of old boilers. It is believed that 1938 boiler house equipment sales will show a continued increase and that more central station construction will be seen.

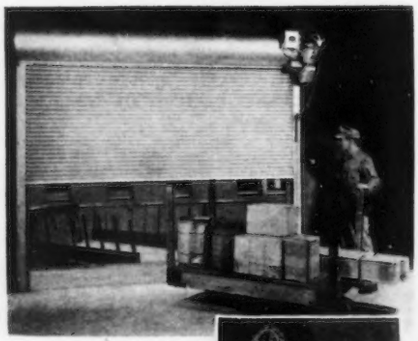
An annoying problem confronting power plant engineers is how to eliminate fly ash, soot and fumes from the air surrounding the plant.

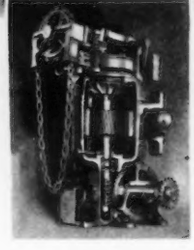


DOUBLE BARRELED

ECONOMY . . . *for Doorways*

When you are aiming for efficiency, durability and complete convenience in service doorways you can't miss when you fire both barrels . . . a Kinnear Steel Rolling Door matched with a Kinnear Power Operator.





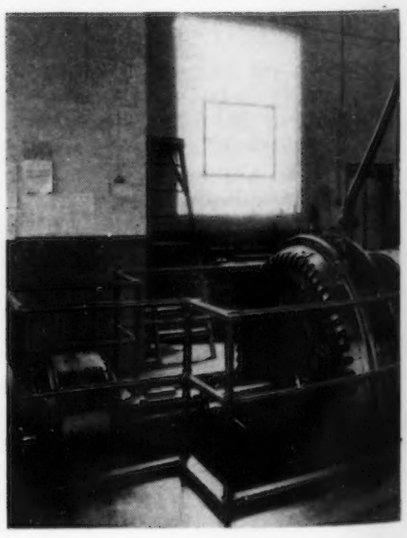
The Kinnear Steel Rolling Door, coiling above the opening, saves space—is out of the way of damage—and is inherently more durable. Combine that with the thoroughly engineered Kinnear Power Operator and the door can then be operated from any number of conveniently located push-button control stations. That means a further saving in time and labor—MONEY. Not to speak of the benefits of a permanent nation-wide service organization.

So, for long range service and satisfaction let Kinnear be your guide. Let them track down the solution to your door problem with "Double-Barreled Economy." With their 42 years of specialized door experience they can design and build a Kinnear Motor Operated Steel Rolling Door for any opening regardless of size, shape or use for which it is intended.

Write for complete details on your problem.

The* KINNEAR *Mfg. Co.

1760-80 FIELDS AVENUE, COLUMBUS, OHIO



REMARKABLE economies have resulted

Although it has been discovered that the burning characteristics of the coal and the design of the furnace have much to do with this difficulty, large plants are having to make use of fans, collectors, sprays, etc., to provide a satisfactory degree of freedom from these evils.

Coal Stokers

Industrial plants of all types are discovering that the coal stoker is a source of economy and operating efficiency from many angles. Hand firing of boilers, whether used for heating alone or both heating and power, is rapidly becoming a thing of the past. The dependability and economy provided by stokers on the market today are winning them an ever-increasing number of users.

A recent development which has greatly increased the efficiency of stokers for industrial and commercial use is a new type of burning head which eliminates the use of dead plates. In addition, laminated tuyeres, with primary and secondary ports provided for maximum efficiency in air distribution, permit greater radiation without danger of warpage.

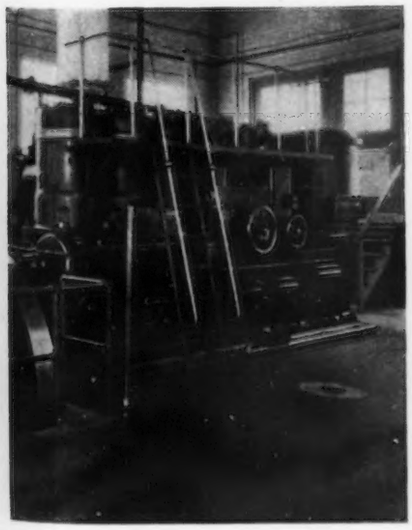
The new burning head is of a sloping design which carries slag to the side walls of the boiler, from where it is easily removed with a hook and slice bar. An added feature is the design of the secondary air ports which are offset in a manner that greatly reduces riddlings.

Coupled with the new type burning head is an improvement in air volume control which places this on a completely automatic basis, eliminating guesswork. Manual control of air volume, in addition to the undesirable feature of requiring constant attention, was never satisfactory because it permitted the factor of human error to enter, which was often great.

The new air control device responds to the resistance created by the depth and thickness of the fuel bed. Thus, when the fuel bed is light and combustion requirements at a minimum, the amount of air supplied to the fuel bed is reduced. When heat or power requirements cause the stoker to feed more coal to the fire, the increased resistance of the heavier fuel bed automatically increases the amount of air in exactly the right proportion.

Other late developments are the pneumatic-spreader and chain-drive underfeed types of stokers.

The first of these combines the features of both underfeed and overfeed types, a worm conveying coal from

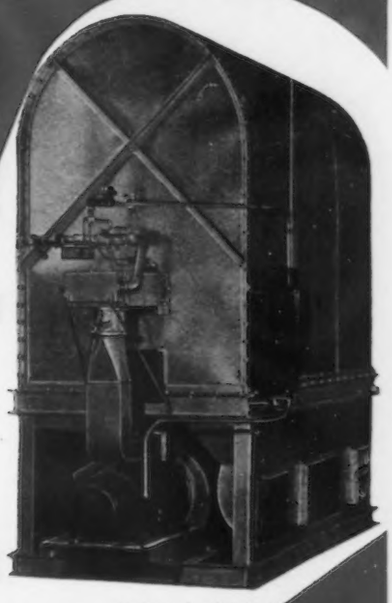


from the use of this 525 hp. 2-cycle diesel.

HEAT WHEN YOU NEED IT AND WHERE YOU NEED IT

JUST AS EASY AS TURNING ON AN ELECTRIC LIGHT AND CAN BE FOCUSED IN SPOTS OR SPREAD UNIFORMLY ACCORDING TO YOUR REQUIREMENTS

WHEN YOU USE THE LEE Direct-Fired UNIT HEATER



(Patents Pending)

With a LEE Direct-Fired UNIT HEATER you have the same ease of control over your heating as you do over your lighting system. In the same manner you can focus or distribute the heat exactly where you need it — no necessity of overheating the top of the building when you need the heat along the floor. Also, you can have heat immediately upon starting the unit — and when you don't need heat you can shut down the unit and not be burdened with stand-by losses.

The LEE System of heating with direct fired warm air has been in successful operation for many years, with hundreds of units installed in various types of industrial plants, shops, warehouses, etc.

Let us quote on your requirements.
Write for new bulletin just off the press.

DRAVO CORPORATION
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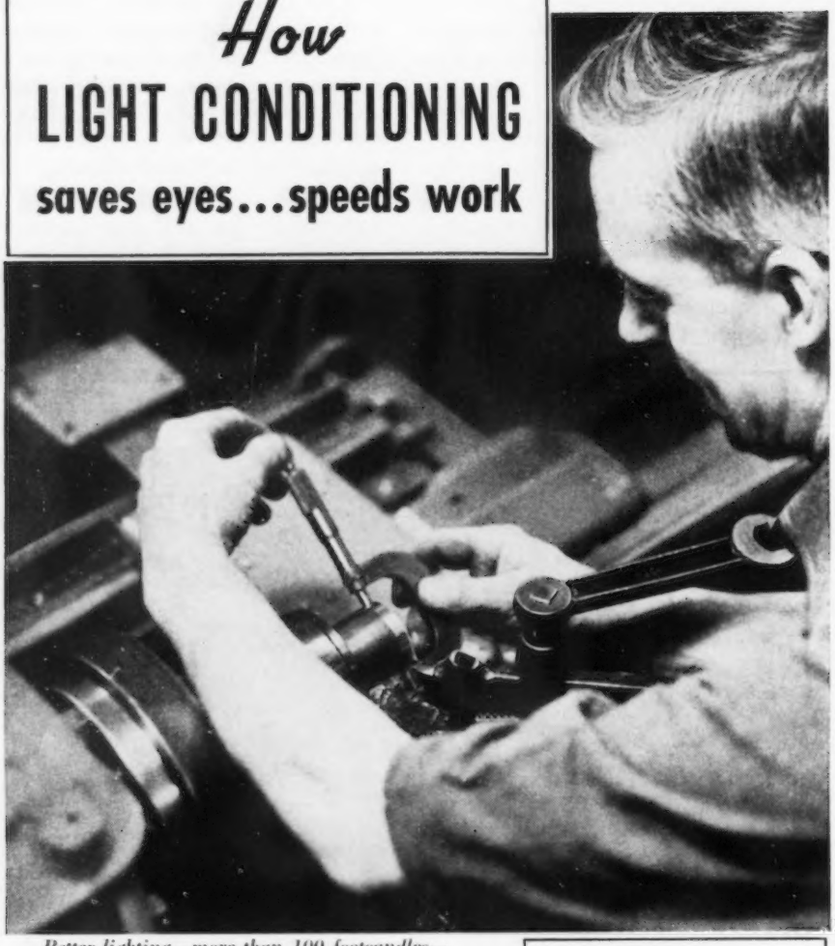
302 PENN AVE. PITTSBURGH, PA.

How LIGHT CONDITIONING saves eyes...speeds work



Better lighting—more than 100 footcandles—helps insure the accuracy of precision work such as making micrometer readings.

Light conditioning in an industrial plant simply means providing the right amount of light and the right kind of lighting for seeing and comfort.

Thanks to lighting research, the kind and amounts of light needed for various industrial processes can easily be determined. For example, certain kinds of close seeing, precision work require 50, 100 or more footcandles of light to be done efficiently and with minimum eyestrain. With a General Electric Light Meter, you and your shop foremen and plant superintendents can measure the light accurately.

USE THE G-E LIGHT METER TO MEASURE YOUR LIGHTING

With a G-E Light Meter you can measure lighting. It shows the amount of light under which seeing tasks are done. Only $11.50

Important to the success of any relighting program is the use of good lamp bulbs. Thrifty industrial purchasers buy Edison MAZDA lamps because these lamps *stay brighter longer* . . . provide more light at no additional cost for current. Use the new, brighter 1938 Edison MAZDA lamps in your plant.

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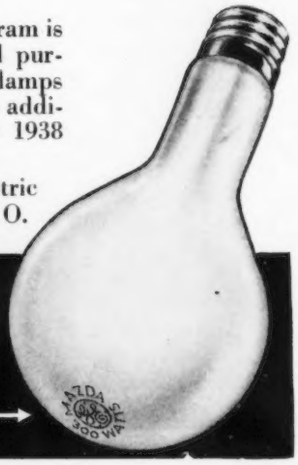

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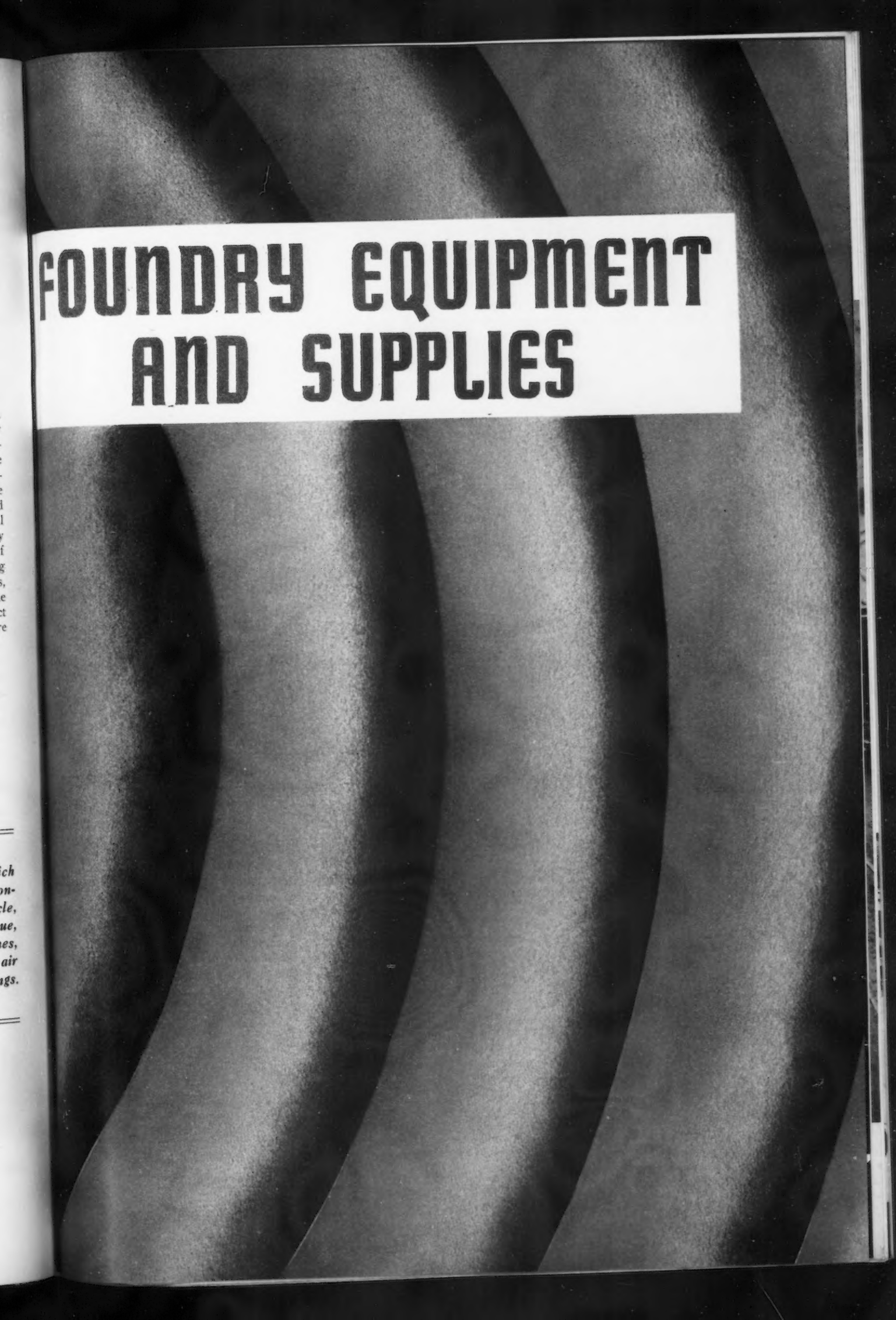
bunker to transfer box, where a stream of high velocity air picks it up and carries it to the boiler. Steam size coal is distributed evenly over a shallow fuel bed in boilers developing up to 500 hp. The stoker can be located to suit conditions, usually from 8 to 15 ft. from the boiler front, leaving room for emergency hand-firing, or in a separate room.

The underdrive stoker is designed for use in boiler rooms where maximum clearance is required immediately in front of the boiler. The cooling of the fuel bed of the underfeed stoker by water is another recent improvement.

The exact manner in which fuel savings are accomplished with coal stokers varies in different plants. In most instances, both less and cheaper coal are burned. Occasionally characteristics of the heating plant make the burning of cheaper coal inadvisable, but in such cases a considerable reduction in the amount of coal used invariably takes place. An exceptional case is a plant which burned slightly more coal during the first year of stoker operation, requirements being approximately the same both years, but a saving of $3.50 per ton on the grade of coal used offset that fact to provide a net economy of more than $300.

AMONG the subjects which will be covered in the concluding installment of this article, to appear in a subsequent issue, will be turbines, diesel engines, pumps, scales, unit heaters, air compressors and plant buildings.


FOUNDRY EQUIPMENT
AND SUPPLIES

FOUNDRY EQUIPMENT AND SUPPLIES

New equipment and supplies expand use of alloy irons by making possible closer control of operations. Dust control in the foundry widened by new apparatus

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By W. A. PHAIR
Associate Editor, THE IRON AGE

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FROM the dark, smoke shrouded buildings of yesteryear to the spacious, airy foundries of today is a long distance. The path from the shacks of the pioneer foundrymen where melting and molding operations were founded on hunches and superstition to the technically controlled process of the modern plant is not a trail blazed with bright lights; it is a modest highway, paved with the courage and painstaking labors of those who built it. To the outside world this trail is, perhaps, unspectacular, but to those privileged to observe the blazing of this path it is filled with the sheer romance of accomplishment.

Progress is based on knowledge that can be converted into control—practical control. The speed with which the technician's complicated formulas have been transferred into solid, efficient mechanisms has been the impelling force behind the development of the foundry.

No machine is ever perfect and the ability of American mechanics to appreciate this and to continually strive to better and refine their equipment makes it difficult to draw a clear line of demarcation between the developments of 1936 and 1937. Many machines introduced in 1936 have been so improved as to be practically new machines this year. Other practices, receiving scant attention in past years, have become the center of attraction in 1937. These conditions conspire to make it difficult to high-spot the year's development without occasionally stepping over the border and placing one foot in 1937 and the other in 1936.

Cupola Operation

Considerable attention during the past year has been directed to the use of balanced blast cupolas in the United States. This type cupola, originally developed by the British Cast Iron Research Association, employs four rows of tuyeres in place of the conventional one row. The bottom row of tuyeres is equipped with gates controllable by wheels mounted outside the blast box.

The first balanced blast stack was installed in England in 1930. Since that time over 150 cupolas of this type have been put in operation. While the majority of these installations were made in England, a large number of applications, including several multiple installations, have been made in Continental foundries. At the close of 1937 seven balanced blast installations were in operation in the United States. The McWane Cast Iron Pipe Co., the licensee in the United States, has three in blast.

The sponsors of the balanced blast cupola state that with the conventional single row of tuyeres, it is difficult to obtain complete combustion of the coke carbon to CO_2, and an analysis of the gases at the charging door of this type furnace will always show the presence of considerable quantities of CO which is completely wasted if allowed to escape up the stack or burn at the charging door.

On the other hand it is claimed that in balanced blast cupolas it is possible to burn this CO gas inside the cupola, utilizing the heat created to melt iron and heat the charge as it descends to the melting zone. The introduction of secondary air through the upper tuyeres is said to afford almost complete combustion and this permits the use of cheaper grades of coke and higher coke-iron ratios.

Substantial data, based on the experience of the McWane Cast Iron Pipe Co., were presented in the Dec. 2, 1937, issue of THE IRON AGE. According to these data, analyses of gases at the charging level of conventional cupolas showed an average of 14.5 per cent CO, or an overall fuel loss of 38.6 per cent. In the bal-

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anced blast cupolas, the analyses showed an average of 4.3 per cent CO, or a total fuel loss of 13.4 per cent. The experience of this company has been that the British type blast arrangement has resulted in net savings of 35 per cent, in addition to increasing the temperature of iron at the spout about 40 deg.

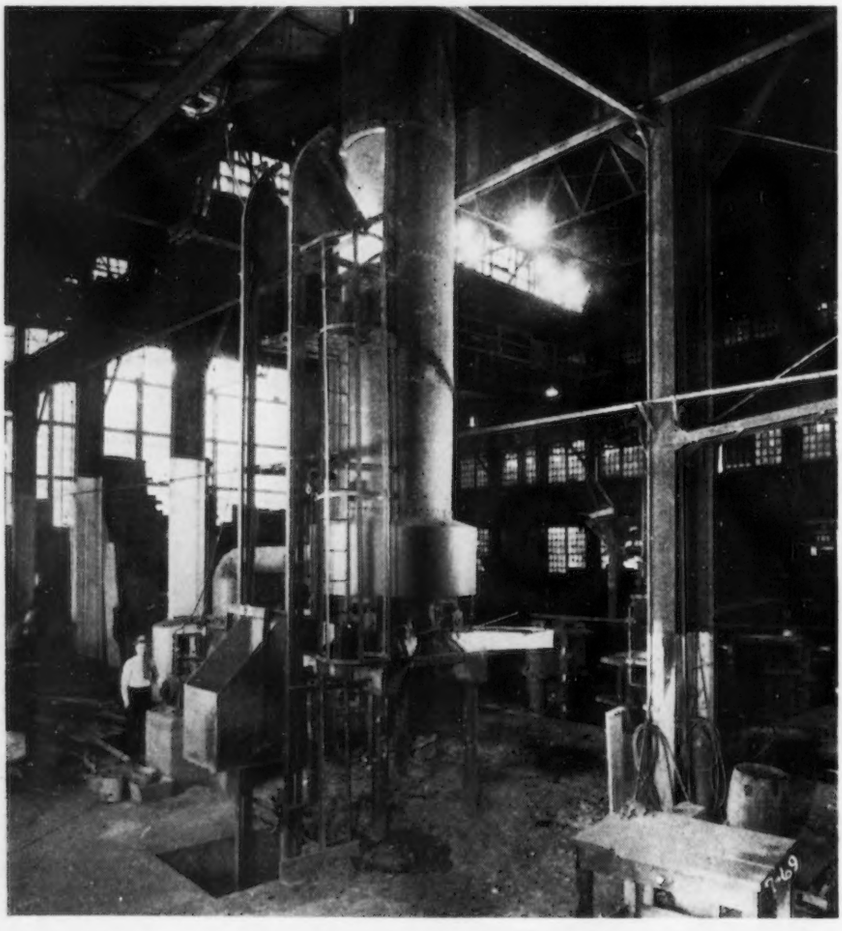
There are many foundrymen[1] of the opinion that the same results can be achieved in ordinary cupolas if they receive the proper attention. Their contention is that the favorable results credited to balanced blast installations came not from the change in blast feeding, but rather from the attention such change-over focuses on the blast manipulation. The use of automatic blower controls that provide the cupola with the exact weight of air required to achieve ideal melting conditions in the stack, will give the same results, it has been stated.

It has also been pointed out that the human element entering the picture in balanced blast cupolas in adjusting the openings of the master tuyeres, injects an undesirable factor into the cupola's functioning that is avoided by the use of automatic blower controls.

The charging of large cupolas has been mechanized to a substantial degree in the past, but the mechanization of small cupolas has been retarded for several reasons, the chief reason being the cost of the installation of mechanical charging equipment in comparison with the cost of the cupola itself. This problem, however, has been skilfully met by the skip hoist charger, introduced by the Whiting Co. This charger consists of an arrangement of cables, a hopper for the charge and a superstructure, and enables the foundryman to load charges into the hopper at the ground level. By pressing a control button the charge is raised to the charging door and dumped into the stack. This type charger eliminates the need for a charging floor and occupies only 6 sq. ft. of floor space for the foundation.

[1] Function of Tuyeres in Cupola Operation, THE IRON AGE, July 29, 1937.

FIG. 1.—Whiting skip hoist charger provides a low cost method for charging small cupolas.



The Richardson charger, developed by the Modern Equipment Co., is designed for charging larger cupolas and also operates from the yard level. Its cycle of operation is entirely automatic and is controlled by push buttons.

Sand Preparation

The most advanced melting practice known and the most modern plant human ingenuity can devise is valueless unless the basic element of all foundry operations—the molding sand—is properly prepared. Cognizance of this fact is evidenced in the many improvements made in sand conditioning equipment.

In the field of portable sand conditioners, a seemingly incongruous yet actually very practical development was the adoption of pneumatic tires as standard equipment on the Royer Foundry & Machine Co.'s line of sand conditioners. Any foundryman who has endeavored to pull a machine of this kind over a half buried clamp or gate, or through a dirt covered molding bay, can readily appreciate the value of this step.

The Speedmuller, a batch-type sand muller perfected by the Beardsley & Piper Co., employs two rubber covered spherical shaped mullers that mull the sand thrown in their path by specially placed plows. Two mullings and four aerating actions take place with each revolution of the shaft. It is said that this machine will deliver 10 cu. ft. of prepared sand every 1.2 min., or 25 tons per hr.

Recent improvements in the Simpson mixer, manufactured by the National Engineering Co., are a simplified method of adjusting plow positions, a higher clearance plow beam and interior sections that tend to shed the sand. The mulling action of this machine is imparted by two heavy wheels, the weights of which are adaptable to the type of sand being prepared.

IN a subsequent issue this article will be concluded with a description of progress in molding machines, dust control, cleaning equipment and methods, chill control and alloy irons.

and INSPECTION

TESTING *and* INSPECTION

Magnetic and X-ray inspection developments paint the background for yet unknown pictures of progress in laboratory and shop control of material quality

o o o

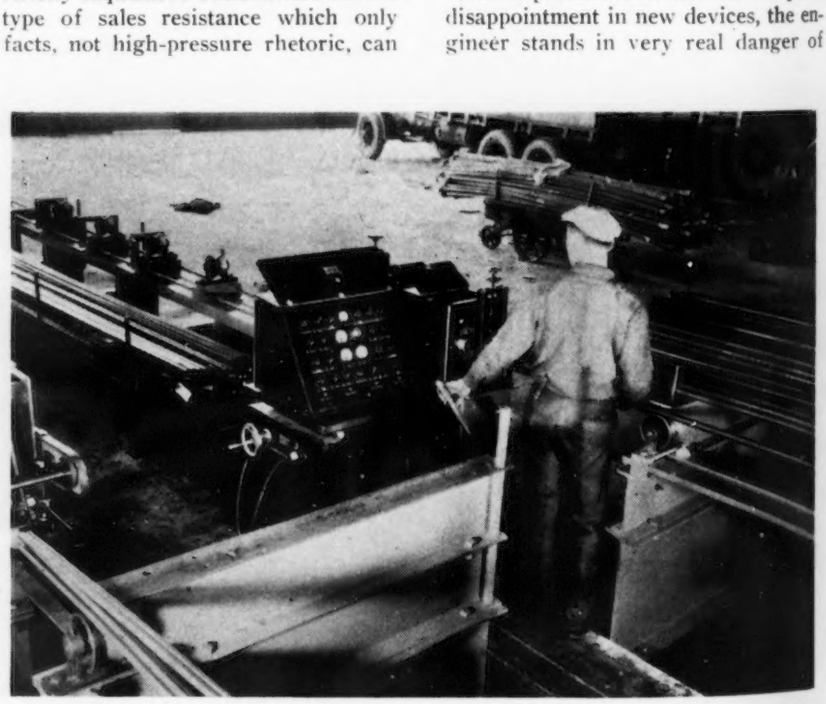
BY ROBERT C. WOODS
Consulting Engineer

o o o

FIFTY-TWO weeks a year the harassed chief of the inspection department is accustomed to answer the buzz of his phone only to hear the usual front office plaint, "Mr. Black of the White Engineering Co. here to see you."

The monotonous parade of individuals who call to sell the plant engineer various forms of testing devices goes on and on without surcease. The man who sits behind the desk before which these legions pass must combine within himself the attributes of many different personalities. First, he must be a thoroughgoing engineer, well grounded in fundamental principles and alertly conscious of modern scientific advances in testing and manufacturing fields. Likewise, he must be able to penetrate beyond the chromium-plated knobs and dials of new instruments and to grasp their real significance relative to the products he inspects. Equally as important, he must be a first-rate economist. He should be capable of visualizing each fraction of a cent added to the cost of his product due to the purchase of testing equipment. Then, he must be easily accessible to those who come offering new wares. The engineer whose door is closed today to the steady influx of modern ideas may easily pass up some worthwhile opportunity which will fail to knock again. With this accessibility, however, he must maintain a strictly inquisitive outlook and have a type of sales resistance which only facts, not high-pressure rhetoric, can penetrate. In other words, the perfect chief inspector is a veritable superman. The job is not an easy one.

Due, perhaps to the continual review of personalities and the frequent disappointment in new devices, the engineer stands in very real danger of



MAGNETIC ANALYSIS CORP.'S 3-in. dual method equipment in actual operation.

developing a lop-sided attitude. The tendency on his part is to strike a mental stance something along the line of, "All right, I'll see what you have to sell, but it better be good." This puts the device at an immediate disadvantage for it presupposes that if the instrument does not work perfectly at once, the principles on which the apparatus is based, the machine itself, and the company making it are all necessarily worthless. If, however, the engineer can discern but a hint of quality in the basic principles of any device, failure to function perfectly the first time should not disqualify it at once. If such an utterance is not heresy, it might be suggested the inspector roll up his sleeves, unlimber his imagination, and use a little of his own ingenuity in an effort to make the other fellow's device work. An attitude of this kind has been known to pay off in dollars and cents.

The purpose of this discussion is to consider in helpful, and hopeful, light four inspection methods which appear to be based on sound fundamental principles. These methods do not always work, but nothing is perfect, and these four prodigies are not long out of the cradle. We may nevertheless discern in them that spark of genius which in maturity leads to greatness.

In any survey of testing, especially of metal testing, the field may roughly be divided into two broad classifications, the microscopic and the macroscopic. In the first, material is considered from the standpoint of the minutae which compose it, while in the latter, substances are thought of from the gross aspect. Under the heading of the very small come such studies as microscopy, X-ray diffraction, and reflection phenomena; under the second division we may include tests like the magnetic and X-ray for cracks, flaws, inclusions, porosity, etc. It is the magnetic and X-ray methods of non-destructive testing which will be considered in this article.

X-Ray Method

Considering the last-mentioned first, it will be found that the art of industrial X-ray diagnosis is quite an advanced branch of science despite its relative newness. The technique and possibilities are well known and predictable. Basic X-ray principles are as clearly defined as any in nature, which probably is not saying much. Nevertheless, it is possible to describe with some confidence how a beam of X-rays will act under most of the circumstances met with in general practice.

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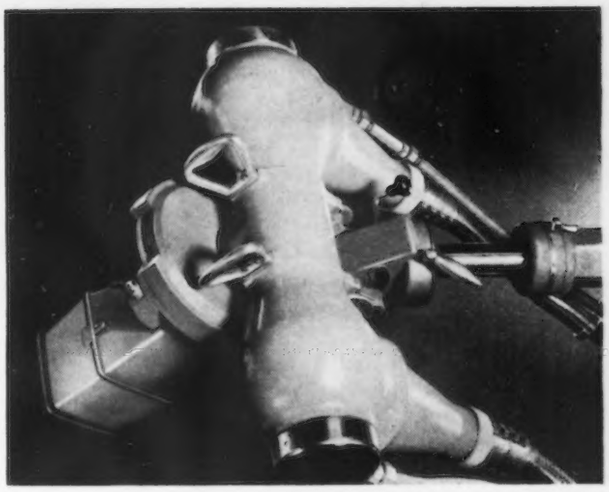

A MODERN shock proof X-ray tube holder on a 200,000-volt machine.

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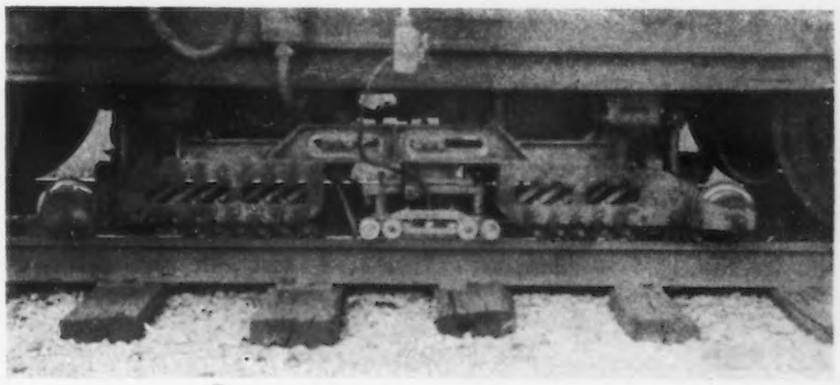
The reason why the laws in this field have been so well formulated is due to the fact that the discovery of X-rays by Röentgen probably contributed more than any other one factor to the development of physics as it is known today. Since the X-ray is the pen which has written most of the facts now regarded as truths about crystals, atoms, electrons, etc., it is not surprising to find its behavior and characteristics somewhat thoroughly plotted.

The whole foundation of industrial radiography, and medical too, is based on the differential absorption of X-rays by matter of varying density. The absorption, of course, is not the same type as the absorption of ink by a blotter. X-rays do not soak into matter and remain fixed there. Far from it. Depending upon the wave lengths composing the X-ray beam, and the crystal structure of the material, etc., some X-rays are scattered from crystal faces, others suffer a variety of mishaps, while some pass through unchanged. The various methods of energy interchange between radiation and matter is a fascinating study, but it might be much simpler just to sum up the whole affair as follows: an X-ray beam aimed at one side of a slice of matter appears on the other side with an intensity from point to point exactly resembling the point to point density of the material through which it has passed. Or for those who are unhappy without formulae, a beam of radiation traversing a layer of substance is reduced in intensity by a constant fraction per centimeter, and after penetrating to a depth x, the intensity is $I = I_o e^{-\mu x}$ where I_o is the intensity at the surface, μ is the linear absorption coefficient, and e is the base of the natural system of logarithms. It is this change in intensity which is recorded on the radiographic film of weld, casting, bar, or other object.

Like every industrial tool, the X-ray has its advantages and disadvantages when compared with other methods. The X-ray is the only way now known, or ever likely to be known, which allows the examiner actually to see the internal conditions of mat-



SPERRY search unit contacts and exploring coils.

ter. This is decidedly important in many cases. Another method might simply indicate the presence of a defect with its approximate location and relative size. In a weld this might be a crack or several small pinholes, the former objectionable, the latter not necessarily so.

X-ray not only discloses the position and extent of the defect, but by stereoscopic means it is possible to visualize the flaw in three dimensions. Moreover, except in the case of extremely complicated objects, shape and size of articles do not present any insurmountable obstacles aside from the small mechanical problems of setting up the equipment, aiming the beam, and placing the films. There can be no question that for the engineer who must see internal conditions, the X-ray has no peer in the nondestructive testing field.

X-ray and magnetic methods could hardly be called real rivals, for each one has its own particular applications which in most cases do not trespass on each other's provinces. X-ray at its best cannot be termed a rapid inspection method nor is it exactly compact, even when using the most modern apparatus. The film must be positioned geometrically and then, after being exposed for the requisite time, must be processed for five minutes or more in a dark-room before the results of the inspection are known. In the case of welds, and with sufficient assistance, it is possible to make the actual exposures at the rate of 1 to 5 ft. per min., but no amount of extra help will in any way cut down the time necessary for developing and fixing films. Various techniques have been devised from time to time where the amount of material examined per minute could be increased to 10 or 12 ft., and such items as the side walls of piston heads have been X-rayed completely around in one exposure, but the cost of special apparatus for these tricks makes their application rare. Where material is being turned out on a quantity basis and minutes are important factors, it is safe to say the X-ray method is much too lengthy. However, it is well within the realm of possibility that improvement in technique, equipment, and fluorescent materials may ultimately result in accurate direct visual inspection of metal products. If fluoroscopic inspection of such materials ever becomes practical, then, of course, the X-ray would be an almost perfect inspection tool.

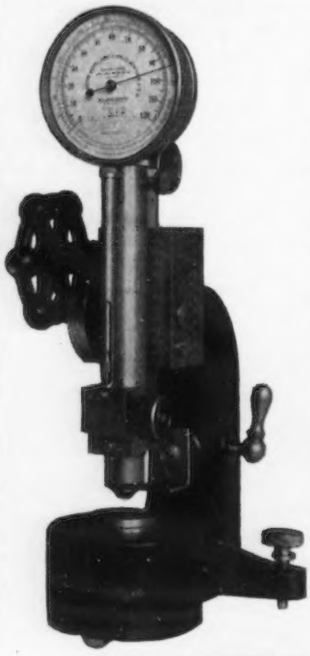
Magnetic Inspection

Turning now from X-rays to magnetism, a different condition of affairs is found. It is true that when the ancestry of X-rays is traced far enough a dark forest of atomic physics is found, with only a dim light available to read a compass of no guaranteed dependability. However, even though only the shadows of trees are found rather than solid substance, certain landmarks may be recognized as being fairly fixed, so that a path may be laid through the field of X-rays with some confidence both as to direction and destination. But in the realm of magnetic testing there is not so much confidence and very little certainty except, of course, in the case of well established constants present in every branch of engineering. It is known, for example, how to produce and regulate an X-ray beam, and it is also known how to produce and regulate a magnetic field, but there the similarity ends; for what changes will occur, and why, due to the presence in the magnetic field of various materials is still mostly speculation. It seems remarkable that with all of today's knowledge of natural matters, no one has yet evolved a completely satisfactory theory of magnetic effects.

The early founding fathers in the art of magnetic testing pompously declared it to be based upon the principle that there is in a metal "one and only one set of magnetic characteristics corresponding to a given set of mechanical characteristics." This naive attitude somehow recalls the pitiful smugness of the nineteenth century physicists and their neat set of classical mechanics within which all nature performed for the benefit of mankind. To those men only the menial task of mopping up around the edges remained, and scientific conquest seemed almost a dead issue. The great Alexander himself could have been no more despondent, once he had conquered all the known world, than were these venerable nineteenth century gentlemen. Today all this is changed, and the stature of a scientist may almost be judged by the ignorance he boasts, while only the small-fry display the cockade of omniscience. In line with this trend the foremost of those engaged in magnetic research freely confess that many relations between magnetism and metallic conditions are still deep waters, unsounded and uncharted.

(TO BE CONCLUDED)

HARDNESS TESTING



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